CHAPTER V

DISCUSSION AND CONCLUSION

1) Results of experiment

The results of the following were statistically average which minimum pieces of specimens were tested as required by each corresponding ASTM material testing specification. The machanical and thermal properties may be summarized as follow:

(1) Tensile Strength

From table 4-1, for GRP, average lengthwise tensile strength was 9.6 % higher than crosswise tensile strength. Statistically the difference was no significance. This phenomena can be explained by random distribution of galss fibre in chopped strand mat yielding the same strain in all direction.

For JRP, average crosswise tensile strength was 35 % higher than lengthwise tensile strength since jute used in the test was braided and crosswise braided jute to lengthwise braided jute was 2 to 1.

Average tensile strength of GRP was 3.6 times higher than average tensile strength of PP since ultimate tensile strength of GRP depends on ultimate tensile strength of glass fibre and ratio of glass fibre area to GRP.

Average tensile strength of jute crosswise reinforced plastic was 7 % higher than average tensile strength of PP and average tensile strength of jute lengthwise reinforced plastic was 30 % lower than average tensile strength of PP. Jute employed in this test was braided jute and ratio of crosswise jute to lengthwise jute was 2 to 1 so it implied that tensile strength of JRP varied with the proportion of jute and plastic.

Average tensile strength of GRP was 4 times higher than tensile strength of JRP since tensile strength of glass fibre is higher than jute.

(2) Young's Modulus

From table 4-1, for GRP, lengthwise Young's modulus was 9.9 % higher than crosswise Young's modulus which was considered to be non-significance difference. The phenomenon can also be explained by random distribution of glass fibre in chopped strand mat yielding the same strain in all direction.

For JRP, crosswise Young's modulus was 6.6 % higher than lengthwise Young's modulus since jute employed was braided jute and in proportional limit, average Young's modulus in both direction are almost the same.

Young's modulus of GRP was 2.7 times higher than Young's modulus of PP since Young's modulus of glass fibre was higher than Young's modulus of PP. Young's modulus of GRP depends on the proportion of glass fibre to pure plastic.

Young's modulus of PP was 1.3 times higher than Young's modulus of JRP since adhesion of plastic is much stronger than cohesion between plastic and jute. The higher proportion between jute and plastic, the lower Young's modulus of JRP is.

Young's modulus of GRP was 3.6 times higher than Young's modulus of JRP since the cohesion between plastic and glass fibre is higher than the cohesion between plastic and jute.

Young's modulus from table A-2 was higher than Young's modulus from table A-6 since Young's modulus obtained from one point testing on each test specimen but Young's modulus obtained from several point testing on each test specimen.

(3) Flexural Strength

For GRP, average lengthwise flexural strength was only 8.9 % higher than crosswise flexural strength due to random distribution of glass fibre in chopped strand mat.

For JRP, average crosswise was 26 % higher than lengthwise flexural strength since jute used in the test was braided jute.

Flexural strength of GRP was 2.8 times higher than flexural strength of PP since PP is hard and brittle but JRP is hard and tough.

Flexural strength of PP was 1.4 times higher than flexural strength of JRP due to weak cohesion of plastic and jute and slip among plastic-jute composite layer. Flexural strength of JRP depends on area of jute-plastic cohesion.

Average flexural strength of GRP was 4 times higher than flexural strength of JRP due to higher ultimate strength of glass fibre and stronger cohesion of glass fibre and plastic.

(4) Flexural Modulus

For GRP, average lengthwise flexural modulus was only 5.8 % higher than crosswise flexural modulus due to non-homogeneous of GRP.

For JRP, average crosswise flexural modulus was only 10.9 % higher than lengthwise flexural modulus due to non-homogeneous of JRP and jute employed was braided jute.

Flexural modulus of GRP was 1.5 times higher flexural modulus of PP due to hard and brittle quality of PP and hard and tough quality of GRP. Flexural modulus varies with slope of load deflection curve m (m= P/δ) and the reverse of deflection . Deflection of GRP was less than that of PP under the same applied load.

Average flexural modulus of JRP was only 3 % higher than flexural modulus of PP. Jute was changed to brittle material by heat from polymerization in specimen forming so JRP reacted as PP in terms of hard and brittle.

Average flexural modulus of GRP was 1.4 times higher than that of JRP since hard and tough quality of GRP and hard and brittle quality of JRP.

(5) Coefficient of Thermal Conductivity

PP and GRP had equal coefficient of thermal concuctivity. JRP had higher coefficient of thermal conductivity than the others.

(6) Poisson's Ratio

For GRP, average lengthwise Poisson's ratio (ν_{12}) was 9.6 % higher than crosswise Poisson's ratio (ν_{21}) since average lengthwise Young's modulus (E_1) was 9.9 % higher than average crosswise Young's modulus (E_2) GRP is orthotropic materials. By use of the condition of symmetry of the compliances ($\frac{\nu_{12}}{E_1} = \frac{\nu_{21}}{E_2}$, ν_{ij} = Poisson's ratio for transverse strain in the j-dircetion when stressed in the i-direction)

For JRP, average crosswise Poisson's ratio (ν_{21}) was 21.6 % higher than lengthwise Poisson'ratio (ν_{12}) since average crosswise Young's modulus (E_2) was 6.6 % higher than lengthwise Young's modulus (E_1). JRP is orthotropic materials. By use of the condition of symmetry of the compliances materials. By use of the condition of symmetry of the compliances ($\nu_{12}/E_1 = \nu_{21}/E_2$; ij = Poisson's ratio for transverse strain in the j-direction when stressed in the i-dircetion) the difference between ν_{12} and ν_{21} could be detected because, in Poisson's ratio testing, the less specimen was used, the more error was introduced.

Average Poisson's ratio of GRP and JRP were less than Poisson's ratio of PP. Due to cohesion of plastic and glass fibre and cohesion of plastic and jute.

Average Poisson's ratio of PP was higher than that of GRP and JRP due to less longitudinal strain if PP resulting from the stronger of adhesion between plastic and plastic than cohesion between jute or glass fibre and plastic ($\nu = \frac{d\epsilon_t/dP}{d\epsilon_1/dP}$).

Average Poisson's ratio of GRP was higher than that of JRP due to less longitudinal strain of GRP resulting from the stronger of cohesion between glass fibre and plastic than cohesion of jute and plastic.

(7) Specific Gravity

Average specific gravity of GRP was 15 % higher than specific gravity of PP since density of glass fibre is higher than density of PP.

Average specific gravity of PP was 6.4 % higher than specific gravity of JRP because density of PP is higher than density of jute.

Average specific gravity of GRP was 20 % higher than specific gravity of JRP since density of glass fibre is higher than density of jute.

(8) Hoop Stress and Longitudinal Stress

From Fig. A-11 to A-14, increasing rate of hoop stress and longitudinal stress on different point of GRP tank in limit since stress varies directly with internal pressure and radius of the tank and reversely with the thickness of the tank and, for the tank of the same size under the same pressure, the stress varies reversely with the thickness of the tank (thickness of JRP tank/thickness of GRP tank = 1.2/0.75 = 1.6)

The cylindrical tanks with hemispherical ends were pressurized until they broke down and it was found that GRP tank could stand the internal pressure 3 times higher than JRP tank could.

It is worth to notice that stress at different point on the cylindrical surface of the cylindrical tank with hemispherical ends were not the same due to unconsistencely thickness of the tank. To smoothen internal surface by completely eliminating air foam was very difficult.

(9) Indicated Load and Elongation Curve

From Fig. A-18 PP broke down under applied tensile load so yield point of PP employed in engineering design was equal to 0.2 % of ultimate stress. Crack at outer surface of PP was observed at breadking stage.

For GRP test specimen under applied tensile load obeyed Hooke's law up to 30 % of ultimate tensile stress. Then the curve began fluctuated until breakage due to the continuation of crack on plastic surface. In engineering design, yield point of GRP was equal to 30 % of ultimate stress or cracking stage.

For JRP test specimen under applied tensile load obeyed Hooke's law up to 50 % of ultimate tensile stress. Then the curve began fluctuated until breakage due to the continuation of crack on plastic surface. Yield point of JRP employed in engineering design was equal to 50 % of ultimate stress or cracking stage.

(10) Indicated Load and Deflection Curve

From Fig. A-19, deflection at the middle of PP specimen varied directly with applied load until breakage. It was observed that crack started at the lower surface of the specimen.

For GRP the test specimen under applied load obeyed Hooke's law until 20 % of ultimate load was applied. Then the curve started fluctuating due to the continuation of crack at the lower surface.

For JRP the test specimen under applied load obeyed Hooke's law until 50 % of ultimate load was applied. Then the curve started fluctuating due to the continuation of crack at the lower surface.

From the experiment it could be concluded that

(I) JRP has lower tensile strength and flexural strength than PP and GRP since jute does not increase the tensile strength of reinforced plastic. However for the work that need not high strength, JRP could be employed to reduce cost.

(II) Changing of weight per unit area and number of ply of reinforcing material had not significance effect on changing of mechanical properties of meterial reinforced plastic.

(III) For cylindrical tanks with hemispherical ends made of GRP can stand the internal pressure 3 times higher than JRP tank.

2) Discussion and Conclusion

The results of the experiments showed that, in general, the mechanical and thermal properties of jute reinforced plastics fall between the fibre-glass reinforced and pure plastics. However, the Young's modulus of JRP is the same as GRP in spite of lower tensile strength. This behavior showed that JRP have higher modulus as tensile strength approaching GRP.

The density of JRP is lower than GRP. This result implied that JRP showed higher viods in the fibrous reinforcement. As a result, stiffness of the materials were increased which affected the overall Young's modulus of the composites.

Tensile strength of JRP is slightly higher in our direction and lower in another. This effects are due to unequal reinforcement in each direction where the ratio was 2 to 1. Therefore, an optimum amount of reinforcement should be established for improvement of tensile strength.

Mechanical proporties of composite materials having different direction of reinforced fibre were different from each other. Specific direction of reinforced fibre created superiority than the other direction. To reinforce plastic mixing direction of reinforced fibre layer to the other is recommended. So the reinforced plastic could tolerate the applied tensile load in any direction better than pure plastic. Nevertheless degree of mixing between pure plastic and reinforced fibre must be considered. Homogeneously mixing was prefered for the improvement of reinforced plastic in terms of desired mechanical proporties. For good mixing, the smaller the size of reinforced fibre the better the degree of mixing.

APPENDIX I

STRAIN GAGE TECHNIQUE[5]

The strain gage is based on the characteristic of metal which changes the electric resistance with the strain caused.

A typical strain gage is shown in Fig. A-1. Metallic resistance foil of several microns thickness is fixed on an electric insulation material called base using an appropriate adhesive. Unnecessary portions of the foil material is eliminated by the process of photo-etching, according to the desired gage pattern. Then, this work is followed by soldering gage leads to lead the resistance change output externally.

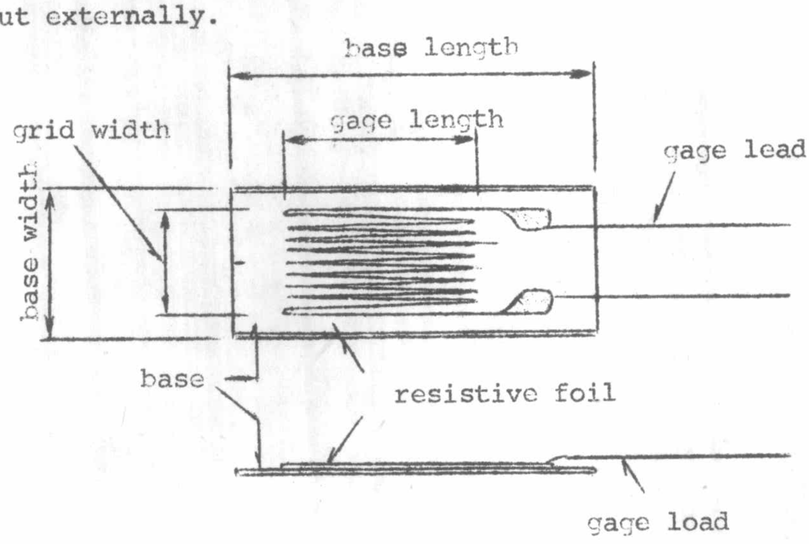

Fig. A-1 GAGE CONSTRUCTION (TYPE KFC-1-C11-11)

Strain measurement by strain gages usually covers measurement of surface strain in the material. Except for special cases, stress determination is made by surface measurement on member materials since the stress due to bending or torsion in each of structure members is greater in the surface or uniform both in the surface and internal with pure tension or compression.

The theory of operation of the metallic resistance gage is relatively simple. When a length of wire (or foil) is mechanically stretched, a longer length of smaller conductor results and the electrical resistance is normally increased. If the length of resistance element is intimately attached to a strained member in such a way that it will also be strained, then the measured change in resistance can be calibrated in terms of the strain, the following equation is obtained:

$$\epsilon = \frac{1}{F}\frac{\Delta R}{R}$$

where ϵ = axial strain

F = gage factor

R = electrical resistance

Value of F and R are supplied by the gage manufacturer, and the user determines R corresponding the input situation he is measuring. This is the fundamental procedure for using resistance strain gages.

If the conductor is strained axially in tension thereby causing an increase in length, the lateral dimension should reduce as a function of Poisson's ratio.

$$F = 1+2\nu + \frac{d\rho/\rho}{\epsilon}$$

where ν = Poisson's ratio

ρ = Specific resistance of the material

Continuous relaxation of the material insures that resistivity should remain constant with strain, then

$$F = 1 + 2\nu$$

the gage factor should be a function of Poisson's ratio alone.

In order to obtain a good result of gage bonding it is essential to finish the surface of measuring spot in a state ready for bonding. Remove rust, paints and platings from the test specimen by the use of grinder and sand-paper. Remove oil and grease with clean absorbent cotton or gauze by using acetone, trioule or other organic solvent. Do not touch the treated surface directly with hand or finger. It is necessary to bond a gage to it quickly without allowing it to be exposed to the air for a long time. Check the insulation resistance of gage generally by means of a vacuum tube voltmeter.

Preparation for measurement

1. Installation of digital strain indicator and automatic multipoint switch box.

2. Connection of cables

3. Grounding the housing

4. Setting the unit No.

5. Gage connection

6. Switching on power

Measurement

1. Automatic initial value measurement

1.1 Set the "SCANNING" switch to "SEQ"

1.2 Set the "FUNCTION" switch to "INIT"

1.3 Set the measurement start point on the "FIRST CH" digital switch and the measurement end point on the "LAST CH" digital switch respectively.

1.4 For print-out recording of the initial value, press the "PRINT" switch to turn "on" the lamp (lamp lights up)

1.5 Press the "START" switch of the SD to start measurement of the initial value.

1.6 When all ASB'S return to the N point state, the "RESET" switch lamp lights up.

1.7 Check the printed-out initial values and make sure that the gage, load cell, etc. Show normal values

2. Automatic measurement

This is a mode for automatic measurement of strain quantities.

2.1 Set the "SCANNING" switch to "SEQ"

2.2 Set the "FUNCTION" switch to"MEAS"

2.3 Set the measurement start point and end point on the "FIRST CH" and LAST CH" switches respectively.

2.4 For print-out, set the "PRINT" switch to "ON" position (lamp lights up)

2.5 After loading the test piece properly, press the "START" switch to start measurement.

2.6 To check the Zero point when the test piece is under no-load condition, follow the procedure described in pars. (2.1) to (2.5) mentioned above before applying load to the test piece.

3. Manual measurement

3.1 Set the "SCANNING" switch to "SIN"

3.2 Set the "FUNCTION" switch to either "INIT" (Initial value is stored) or "MEAS" (true strain quantities are measured).

3.3 Set the measurement start point and measurement end point on the "FIRST CH" and "LAST CH" switches respectively.

3.4 Pressing the "START" switch cause rapid scanning up to the measurement start point

3.5 Each time the "STEP" switch is pressed, the measuring point is changed over to the next point point by point

3.6 For print-out recording, press the "PRINT" switch once, and print-out is performed once.

3.7 Once measurement is done to the measurement and point, pressing the "STEP" switch for a second time causes the reset condition automatically, and the ASB returns to the N point to light up the "RESET" switch lamp. To finish the measurement in the midway press the "RESET" switch.

APPENDIX II

STRESS ANALYSIS[5]

In stress measurement on structures, when the magnitude and direction of principal strain are to be determined, a rosette in which strain gages are arranged at 45° or 60° is used.

Substituting the value of strain measured by each gage in the following equation, the quantity and direction of the principal strain and the maximum shear strain are obtained.

When a 3-axial rosette with gages arranged at 45° as shown in Fig. A-2 is used, the magnitude of principal strain is given by the equations (A-1)

$$\epsilon_1 = \frac{1}{2}\left[\epsilon_a + \epsilon_c + \sqrt{2(\epsilon_a - \epsilon_b)^2 - 2(\epsilon_b - \epsilon_c)^2}\right]$$

....(A-1)

$$\epsilon_2 = \frac{1}{2}\left[\epsilon_a + \epsilon_c - \sqrt{2(\epsilon_a - \epsilon_b)^2 - 2(\epsilon_b - \epsilon_c)^2}\right]$$

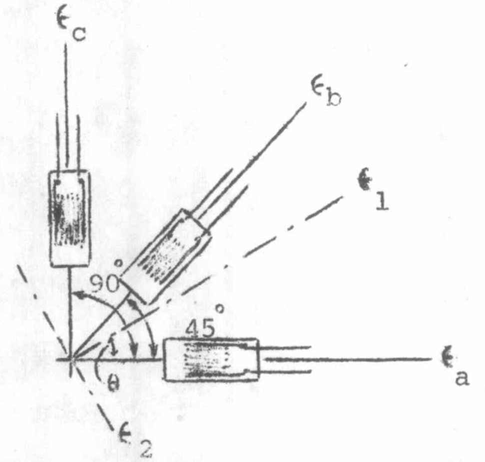

Fig. (A-2) STRESS ANALYSIS BY ROSETTE GAGE

(TYPE KFC - 2 - D17 - 11)

where ϵ_a, ϵ_b and ϵ_c are indicated strains by each of the gages in Fig. A-2

The direction, of principal strain (the same direction as the principal stress) can be calculated by equation (A-2). The value of θ is positive for counter-clockwise direction.

$$\theta = \frac{1}{2} \tan^{-1}\left[\frac{2\epsilon_b - \epsilon_a - \epsilon_c}{\epsilon_a - \epsilon_c}\right] \qquad \text{(A-2)}$$

And the maximum ϵ_c value of shear strain is sought from equation (A-2)

$$\gamma_{max} = \sqrt{2(\epsilon_a - \epsilon_b)^2 - (\epsilon_b - \epsilon_c)^2} \qquad \text{(A-3)}$$

If the elasticity modulus of material tested and Poisson's ratio are E and ν respectively, the stress can be directly obtained as follows:

$$\sigma_1 = \frac{E}{2(1-\nu^2)}\left[(1+\nu)(\epsilon_a+\epsilon_c) + (1-\nu)\sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b - \epsilon_c)^2}\right]$$

(A-4)

$$\sigma_2 = \frac{E}{2(1-\nu^2)}\left[(1+\nu)(\epsilon_a+\epsilon_c) - (1-\nu)\sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b - \epsilon_c)^2}\right]$$

$$\tau_{max} = \frac{E}{2(1-\nu)}\sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b-\epsilon_c)^2} \qquad \text{(A-5)}$$

where ϵ_1, ϵ_2 : Principal strains

σ_1, σ_2 : Principal stresses

γ_{max} : maximum shear strain

τ_{max} : maximum shear stress

θ : angle made by ϵ_a and ϵ_1

Generally $\epsilon_1 > \epsilon_2$

When bonding a rosette, in what direction axis ϵ_a should be placed is often a problem. However, it is a common practice to bond the rosette in a direction similar to that of the maximum strain ϵ_1 after the latter is assumed.

When a 3-axial rosette with equiangular gages as shown in Fig. A-3 is used, the magnitude of principal strain is given by the equations (A-6)

$$\epsilon_1 = \frac{1}{3}\left[\epsilon_a+\epsilon_b+\epsilon_c+\sqrt{2(\epsilon_a-\epsilon_b)^2+2(\epsilon_b-\epsilon_c)^2+2(\epsilon_c-\epsilon_a)^2}\right]$$
$$\epsilon_2 = \frac{1}{3}\left[\epsilon_a+\epsilon_b+\epsilon_c-\sqrt{2(\epsilon_a-\epsilon_b)^2+2(\epsilon_b-\epsilon_c)^2+2(\epsilon_c-\epsilon_a)^2}\right] \quad \text{(A-6)}$$

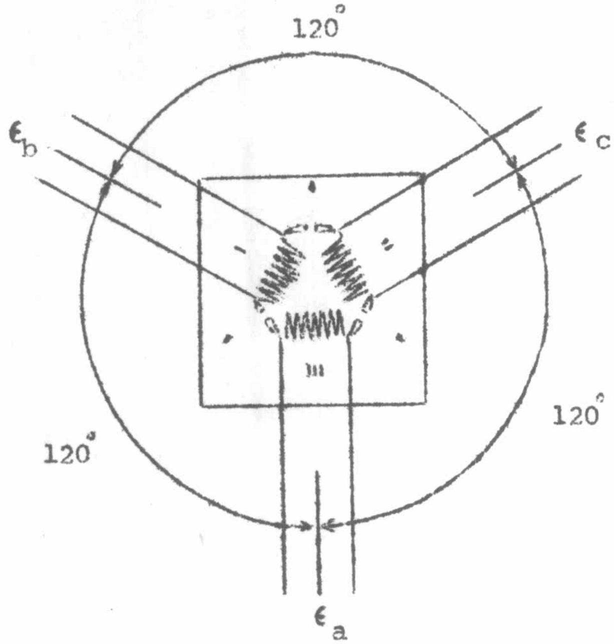

Fig. A-3. ROSETTE GAGE (TYPE KFC - 2 - D4 - 11)

And $\theta = \frac{1}{2} \tan^{-1} \left[\frac{3(\epsilon_c - \epsilon_b)}{2\epsilon_a - \epsilon_b - \epsilon_c} \right]$

$$\sigma_1 = \frac{E}{3(1-\nu^2)} \Big[(1+\nu)(\epsilon_a + \epsilon_b + \epsilon_c) + (1-\nu)\sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b-\epsilon_c)^2 + 2(\epsilon_c-\epsilon_a)^2} \Big]$$

(A-7)

$$\sigma_2 = \frac{E}{3(1-\nu^2)} \Big[(1+\nu)(\epsilon_a + \epsilon_b + \epsilon_c) - (1-\nu)\sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b-\epsilon_c)^2 + 2(\epsilon_c-\epsilon_a)^2} \Big]$$

$$\tau_{max} = \frac{E}{3(1+\nu)} \sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b-\epsilon_c)^2 + 2(\epsilon_c-\epsilon_a)^2} \qquad \text{(A-8)}$$

APPENDIX III

SAMPLE OF CALCULATIONS

1) Tensile Strength

$$\sigma_T = \frac{P}{A} \quad \text{.......................(A-9)}$$

For 3PClP 450 :

A = cross section area of test specimen

= 0.2655 cm^2

P = corrected load

= 105.84 kg

$$\therefore \sigma_T = \frac{105.84}{0.2655}$$

= 398.644 ksc

2) Young's Modulus

$$E = \frac{\Delta\sigma}{A.\Delta\epsilon}$$

$$= \frac{\Delta P}{A.\Delta\epsilon} \quad \text{(A-10)}$$

For 3PClP 450 :

A = cross section area of test specimen

= 0.2655 cm^2

$\Delta \epsilon$ = increment strain from load-elongation curve

= 0.0655

ΔP = increment corrected load from load-elongation curve

= 105.871 kg

$$\therefore E = \frac{105.871}{0.2655 \times 0.0655}$$

= 6,087.935 ksc

3) Flexural Strength

$$S = \frac{3PL}{2bd^2} \qquad \text{(A-11)}$$

For 3PC1P 450 :

d = depth of beam tested

= 0.2108 cm

b = width of beam tested

= 2,4968 "

L = span

= 2.5 "

P = load at a given point on the load deflection curve

= 10.691 kg

$$\therefore S = \frac{3x10.691 \times 2.5}{2x2.4968(0.2108)^2}$$

= 361.347 ksc

4) Flexural Modulus

$$E_B = \frac{L^3 m}{4bd^3} \qquad (A-12)$$

For 3PC1P 450 :

d = depth of beam tested

= 0.2108 cm

b = width of beam tested = 2.4968 "

L = span

= 2.5 "

M = slope of the tangent to the initial straight line portion of the load deflection curve

= 118.987 kg/cm

$$\therefore \quad E_B = \frac{(2.5)^3 \times 118.987}{4 \times 2.4968(0.2108)^3}$$

= 19,873.025 ksc

5) Specific Gravity

$$Sp\ gr = \frac{a}{a + w - b} \qquad (A-13)$$

For 3PC1P450

a = apparent weight of specimens, without wire, in air

= 1,550 mg

b = apparent weight of specimens completely immersed and of the wire partially immersed in liquid.

= 720 mg

w = apparent weight of partially immersed wire

= 440 "

$$\therefore \quad \text{Sp gr} = \frac{1,550}{1550+440-720}$$

$$= 1.22$$

6) Poisson's Ratio and Young's Modulus

$$\nu = \frac{d\epsilon_t/dP}{d\epsilon_1/dP} \qquad \text{(A-14)}$$

From equation (A-6) for pure plastic in Table A-6 at load 30 kg

$$\epsilon_1 = \frac{1}{3}\left[\epsilon_a+\epsilon_b+\epsilon_c+\sqrt{2(\epsilon_a-\epsilon_b)^2+2(\epsilon_b-\epsilon_c)^2+2(\epsilon_c-\epsilon_a)^2}\right]$$

$$= \frac{1}{3}\left[0.0132-0.0006-0.0001 + \sqrt{2(0.0132+0.0006)^2+2(-0.0006+0.0001)^2 +2(-0.0001-0.0132)^2}\right]$$

$$=0.0132$$

$$\epsilon_t = \frac{1}{3}\left[\epsilon_a+\epsilon_b+\epsilon_c-\sqrt{2(\epsilon_a-\epsilon_b)^2+2(\epsilon_b-\epsilon_c)^2+2(\epsilon_c-\epsilon_a)^2}\right]$$

$$= \frac{1}{3}\left[0.0132-0.0006-0.0001 - \sqrt{2(0.0132+0.0006)^2+2(-0.0006+0.0001)^2 +2(-0.0001-0.0132)^2}\right]$$

$$= -0.0049$$

From Fig. A-8 we have

$$d\epsilon_1/dP = \frac{0.0175-0.0132}{45 - 30}$$

$$= 0.0002866$$

$$d\epsilon_t/dP = \frac{0.0067-0.0049}{45 - 30}$$

$$= 0.00012$$

$$\therefore \quad \nu = \frac{0.00012}{0.0002866}$$

$$= 0.42$$

From Fig. A-9 we have

$$d\sigma = 52.941-35.294$$

$$= 17.647 \quad \text{ksc}$$

$$d\epsilon_1 = 0.0175-0.0132$$

$$=0.0043$$

$$\therefore \quad E = \frac{d\sigma}{d\epsilon_1}$$

$$= \frac{17.647}{0.0043}$$

$$= 4,103.953 \quad \text{"}$$

7) Longitudinal Stresses under Internal Pressure For cylindrical tank with hemispherical ends made of GRP, internal pressure 0.3515 ksc at a strain gage that point no. 3

$$\sigma_1 = \epsilon E \qquad \text{(A-15)}$$

$$= 0.00064 \times 17,118.089$$

$$= 10.956 \qquad \text{ksc}$$

at strain gage that point no.4,5,6

From equation (A-4) and Table A-7 we have

$$\sigma_1 = \frac{E}{2(1-\nu^2)} \Big[(1+\nu)(\epsilon_a+\epsilon_c)+(1-\nu) \cdot \sqrt{2(\epsilon_a-\epsilon_b)^2 + 2(\epsilon_b-\epsilon_c)^2}$$

$$= \frac{17,118.089}{2(1-0.362^2)} \Big[(1+0.362)(0.00012+0.0029) + (1-0.362) \sqrt{2(0.00012-0.00003)^2 + 2(0.00003-0.0029)^2} \Big]$$

$$= 7.318 \qquad \text{ksc}$$

$$\sigma_2 = \frac{E}{2(1-\nu^2)} \Big[(1+\nu)(\epsilon_a+\epsilon_c)-(1-\nu) \cdot \sqrt{2(\epsilon_a-\epsilon_b)^2+2(\epsilon_b-\epsilon_c)^2} \Big]$$

$$= \frac{17,118.089}{2(1-0.362^2)} \Big[(1+0.362)90.00012+0.00029) - (1-0.362) \sqrt{2(0.00012-0.00003)^2 + 2(0.00003-0.00029)^2} \Big]$$

$$= 3.68 \qquad \text{Ksc}$$

From equation (A-2)

$$\theta = \tfrac{1}{2}\tan^{-1}\left[\frac{2\epsilon_b-\epsilon_a-\epsilon_c}{\epsilon_a-\epsilon_c}\right]$$

$$= \tfrac{1}{2}\tan^{-1}\left[\frac{2(0.00003)-0.00012-0.00029}{0.00012-0.00029}\right]$$

$$= 32.047^{\circ}$$

From Mohr's circle

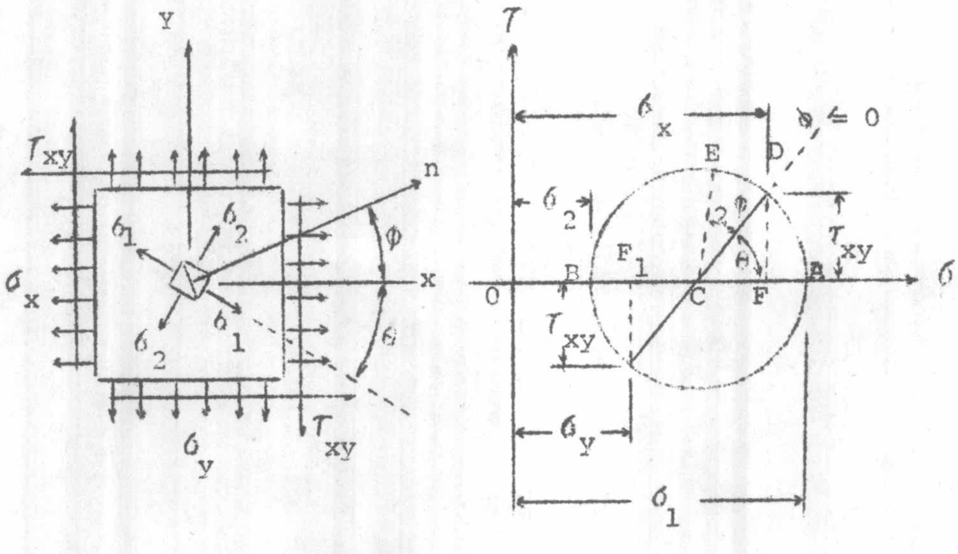

Fig. A-5 THE GENERAL CASE OF PLANE STRESS AND MOHR'S CIRCLE

$$\sigma_x = \frac{(\sigma_1+\sigma_2)}{2} + \frac{(\sigma_1-\sigma_2)}{2}\cos 2\theta \qquad \text{(A-16)}$$

$$\sigma_y = \frac{(\sigma_1+\sigma_2)}{2} - \frac{(\sigma_1-\sigma_2)}{2}\cos 2\theta$$

$$\therefore \sigma_x = \sigma_1$$

$$= \frac{(7.318+3.68)}{2} + \frac{(7.318-3.68)}{2}\cos(2\times 32.047^{\circ})$$

$$= 6.294 \quad \text{ksc}$$

$$\sigma_y = \sigma_h$$

$$= \frac{(7.318+3.68)}{2} - \frac{(7.318-3.68)}{2} \cos (2x32.047^{\circ})$$

$$= 4.704 \quad \text{ksc}$$

8) Hoop Stresses under Internal Pressure

For cylindrical sphere tank made of JRP, internal pressure 0.3515 ksc at a strain gage that point no.25

$$\sigma_h = \epsilon E$$

$$= 0.0095 \times 4,773.837$$

$$= 45.351 \quad \text{ksc}$$

APPENDIX IV

TABLE OF DATA AND RESULTS OF PLASTIC

TAPLE A-1 DATA AND RESULTS OF TENSILE STRENGTH

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA (cm^2)	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH (kg/cm^2)
3PC 1 P450	1.2903	0.2057	0.2655	95.256	105.840	398.644
3PC 2 P450	1.2725	0.2070	0.2634	113.400	126.000	478.360
3PC 3 P450	1.2979	0.2037	0.2644	108.864	120.960	457.489
3PC 4 P450	1.2954	0.2050	0.2655	108.864	120.960	455.593
3PC 5 P450	1.2294	0.1976	0.2429	97.070	107.860	444.051
3PC 6 P450	1.2598	0.1961	0.2470	80.741	89.710	363.198
3PL 1 P450	1.3513	0.1961	0.2650	93.442	103.820	391.774
3PL 2 P450	1.2751	0.1976	0.2520	90.720	100.800	400.000
3PL 3 P450	1.2776	0.1986	0.2538	101.606	112.900	444.839
3PL 4 P450	1.2776	0.1971	0.2518	105.235	116.930	464.377
3PL 5 P450	1.3005	0.2045	0.2659	90.720	100.800	379.090
3PL 6 P450	1.2954	0.2151	0.2787	99.792	110.880	397.847

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH (kg/cm^2)
3PC 1 P600	1.3030	0.2870	0.3740	151.502	168.340	450.107
3PC 2 P600	1.2649	0.2680	0.3390	111.586	123.980	365.723
3PC 3 P600	1.2395	0.2832	0.3510	115.214	128.020	364.729
3PC 4 P600	1.2446	0.2875	0.3579	120.658	134.060	374.574
3PC 5 P600	1.2268	0.2781	0.3412	117.936	131.040	384.056
3PC 6 P600	1.2497	0.2830	0.3536	109.771	121.970	344.938
3PL 1 P600	1.2776	0.2753	0.3518	110.678	122.976	349.562
3PL 2 P600	1.2954	0.2786	0.3610	127.915	142.130	393.712
3PL 3 P600	1.3005	0.2758	0.3587	127.915	142.130	396.236
3PL 4 P600	1.2954	0.2718	0.3521	129.730	144.140	409.372
3PL 5 P600	1.2852	0.2769	0.3558	129.730	144.140	405.115
3PL 6 P600	1.3005	0.2794	0.3634	127.915	142.130	391.112

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH (kg/cm^2)
3PC 1 G450	1.2878	0.2106	0.2712	326.590	380.000	1,401.180
3PC 2 G450	1.2725	0.1991	0.2534	263.090	300.000	1,183.899
3PC 3 G450	1.2802	0.2413	0.3089	290.300	335.00	1,084.493
3PC 4 G450	1.2929	0.2482	0.3208	333.400	387.000	1,206.359
3PC 5 G450	1.3005	0.2395	0.3115	344.740	400.000	1,284.109
3PC 6 G450	1.2446	0.2184	0.2719	282.140	323.000	1,187.937
3PL 1 G450	1.4021	0.2273	0.3187	367.420	430.000	1,349.231
3PL 2 G450	1.2116	0.2677	0.3244	326.590	380.000	1,171.393
3PL 3 G450	1.2878	0.2413	0.3107	-	-	-
3PL 4 G450	1.3056	0.2210	0.2885	285.770	330.000	1,143.848
3PL 5 G450	1.2344	0.2413	0.2979	303.910	350.000	1,174.891
3PL 6 G450	1.2471	0.2451	0.3057	303.910	350.000	1,144.913

TAPLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH (kg/cm^2)
3PC 1 G600	1.2675	0.2990	0.3789	390.100	460.000	1,214.041
3PC 2 G600	1.2700	0.3454	0.4387	473.560	575.000	1.310.691
3PC 3 G600	1.2370	0.3150	0.3896	462.670	560.000	1,437.372
3PC 4 G600	1.2471	0.2858	0.3564	411.870	490.000	1,374.860
3PC 5 G600	1.2471	0.3124	0.3896	480.820	585.000	1,501.540
3PC 6 G600	1.2650	0.3556	0.4498	371.950	440.000	978.213
3PL 1 G600	1.2573	0.2725	0.3427	523.910	642.000	1,873.359
3PL 2 G600	1.2979	0.2720	0.3531	483.080	589.000	1,668.083
3PL 3 G600	1.3005	0.2845	0.3700	453.600	545.000	1,472.973
3PL 4 G600	1.2497	0.2985	0.3730	544.320	670.000	1,796.247
3PL 5 G600	1.2344	0.3124	0.3857	498.960	609.000	1,578.947
3PL 6 G600	1.2471	0.3886	0.4847	449.060	538.000	1,109.965

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH (kg/cm^2)
3PC 1 J450	1.2675	0.3358	0.4256	199.580	225.000	528.665
3PC 2 J450	1.2471	0.3272	0.4080	192.780	219.000	536.765
3PC 3 J450	1.2802	0.3531	0.4520	181.440	206.000	455.752
3PC 4 J450	1.3157	0.3454	0.4545	172.370	195.000	429.043
3PC 5 J450	1.3335	0.3777	0.5037	199.580	225.000	446.694
3PC 6 J450	1.2649	0.3386	0.4283	172.370	195.000	455.288
3PL 1 J450	1.2929	0.3269	0.4226	92.990	105.000	248.462
3PL 2 J450	1.2598	0.3531	0.4448	103.420	118.000	265.288
3PL 3 J450	1.2776	0.3302	0.4219	104.330	119.000	282.057
3PL 4 J450	1.3056	0.3320	0.4334	83.920	94.000	216.890
3PL 5 J450	1.2700	0.3647	0.4632	83.920	94.000	202.936
3PL 6 J450	1.2725	0.3937	0.5010	104.330	119.000	237.525

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W_{cm}	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH (kg/cm^2)
3PC 1 J600	1.2649	0.4008	0.5070	140.620	160.000	315.582
3PC 2 J600	1.2548	0.4252	0.5335	129.280	146.000	273.664
3PC 3 J600	1.2471	0.4059	0.5062	131.540	148.000	292.375
3PC 4 J600	1.2268	0.4089	0.5017	146.060	166.000	330.875
3PC 5 J600	1.2167	0.4247	0.5167	117.940	133.000	257.403
3PC 6 J600	1.2649	0.4318	0.5462	140.620	160.000	292.933
3PL 1 J600	1.2903	0.4089	0.5277	115.670	132.000	250.142
3PL 2 J600	1.3106	0.4001	0.5243	108.860	121.000	230.784
3PL 3 J600	1.2598	0.4044	0.5094	108.860	121.000	237.534
3PL 4 J600	1.2700	0.4153	0.5274	118.840	133.000	252.181
3PL 5 J600	1.2471	0.4348	0.5423	115.670	132.000	243.408
3PL 6 J600	1.2522	0.4280	0.5359	106.600	120.000	223.922

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
4PC 1 P450	1.2573	0.2786	0.3503	127.010	144.000	411.076
4PC 2 P450	1.2471	0.2794	0.3485	119.750	137.000	393.113
4PC 3 P450	1.3335	0.2946	0.3929	120.200	138.000	351.234
4PC 4 P450	1.2954	0.2845	0.3685	108.860	122.000	331.072
4PC 5 P450	1.3005	0.2703	0.3515	-	-	-
4PC 6 P450	1.3157	0.2837	0.3733	126.100	143.000	383.070
4PL 1 P450	1.2522	0.2642	0.3308	120.200	138.000	417.171
4PL 2 P450	1.2471	0.2845	0.3548	107.960	122.000	343.856
4PL 3 P450	1.2370	0.3023	0.3739	109.770	137.000	366.408
4PL 4 P450	1.2192	0.2794	0.3406	-	-	-
4PL 5 P450	1.2979	0.2845	0.3692	129.280	146.000	395.450
4PL 6 P450	1.2903	0.2845	0.3671	142.430	160.000	435.849

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
4PC 1 P600	1.2878	0.4267	0.5495	149.690	169.000	307.552
4PC 2 P600	1.2751	0.4216	0.5376	151.960	172.000	319.940
4PC 3 P600	1.2446	0.4318	0.5473	146.060	167.000	305.134
4PC 4 P600	1.2548	0.4242	0.5322	164.660	187.000	351.372
4PC 5 P600	1.2700	0.4369	0.5548	190.510	216.000	389.329
4PC 6 P600	1.2751	0.3937	0.5020	151.500	171.000	340.637
4PL 1 P600	1.2497	0.3785	0.4730	15 4.220	175.000	369.979
4PL 2 P600	1.2319	0.3772	0.4647	179.170	200.000	430.385
4PL 3 P600	1.3335	0.3874	0.5165	147.870	167.000	323.330
4PL 4 P600	1.2573	0.3581	0.4503	163.300	186.000	413.058
4PL 5 P600	1.3970	0.4013	0.5606	185.070	210.000	374.599
4PL 6 P600	1.3919	0.3683	0.5126	195.050	222.000	433.086

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
4PC 1 G450	1.2167	0.3251	0.3956	421.850	500.000	1,263.903
4PC 2 G450	1.2167	0.2921	0.3554	444.530	534.000	1,502.532
4PC 3 G450	1.1938	0.3759	0.4488	410.510	486.000	1,082.888
4PC 4 G450	1.1963	0.3302	0.3950	353.810	412.000	1,043.038
4PC 5 G450	1.1862	0.3302	0.3917	442.260	530.000	1,353.076
4PC 6 G450	1.1811	0.3480	0.4110	347.220	440.000	1,070.560
4PL 1 G450	1.3081	0.2985	0.3904	488.980	597.000	1,529.201
4PL 2 G450	1.2573	0.3404	0.4279	439.990	526.000	1,229.259
4PL 3 G450	1.2497	0.3073	0.3841	454.510	547.000	1,424.108
4PL 4 G450	1.2548	0.3327	0.4175	428.650	510.000	1,221.557
4PL 5 G450	1.2370	0.3454	0.4273	412.780	491.000	1,149.076
4PL 6 G450	1.2700	0.2858	0.3629	417.310	495.000	1,364.012

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
4PC 1 G600	1.2700	0.3988	0.5065	580.610	711.000	1,403.751
4PC 2 G600	1.2700	0.4369	0.5548	586.060	720.000	1,297.765
4PC 3 G600	1.2700	0.4877	0.6194	576.070	707.000	1,141.427
4PC 4 G600	1.2675	0.4496	0.5698	567.000	698.000	1,224.991
4PC 5 G600	1.2598	0.4318	0.5440	555.660	685.000	1,259.191
4PC 6 G600	1.2903	0.4597	0.5932	576.980	708.000	1,193.527
4PL 1 G600	1.2802	0.4293	0.5495	712.150	862.000	1,568.699
4PL 2 G600	1.2497	0.4267	0.5333	635.040	779.000	1,460.716
4PL 3 G600	1.2395	0.4039	0.5006	703.080	852.000	1.701,958
4PL 4 G600	1.2319	0.4216	0.5194	557.930	686.000	1,320.755
4PL 5 G600	1.2192	0.4470	0.5450	734.830	890.000	1,633.028
4PL 6 G600	1.2090	0.4102	0.4960	580.610	711.000	1,433.468

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
4PC 1 J450	1.2497	0.4445	0.5555	289.400	330.000	594.059
4PC 2 J450	1.1963	0.4470	0.5348	244.940	280.000	523.560
4PC 3 J450	1.2014	0.5588	0.6714	215.910	247.000	367.888
4PC 4 J450	1.1811	0.5156	0.6090	244.940	280.000	459.770
4PC 5 J450	1.1887	0.5105	0.6069	220.450	250.000	411.929
4PC 6 J450	1.1684	0.4801	0.5609	240.410	275.000	490.283
4PL 1 J450	1.2700	0.4750	0.6032	124.740	144.000	238.727
4PL 2 J450	1.2573	0.4724	0.5940	122.470	140.000	235.690
4PL 3 J450	1.2446	0.4674	0.5817	127.010	146.000	250.988
4PL 4 J450	1.2497	0.4851	0.6063	145.150	166.000	273.792
4PL 5 J450	1.2751	0.4826	0.6154	117.940	133.000	216.120
4PL 6 J450	1.2954	0.4470	0.5791	137.890	155.000	267.657

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
4PC 1 J600	1.2675	0.5283	0.6696	197.770	223.000	333.035
4PC 2 J600	1.2675	0.5791	0.7340	205.030	235.000	320.163
4PC 3 J600	1.2979	0.5613	0.7286	224.530	258.000	354.104
4PC 4 J600	1.3259	0.5639	0.7476	223.170	257.000	343.767
4PC 5 J600	1.3081	0.5537	0.7243	172.370	196.000	270.606
4PC 6 J600	1.3081	0.5766	0.7542	175.090	198.000	262.530
4PL 1 J600	1.2319	0.5512	0.6790	145.150	166.000	244.477
4PL 2 J600	1.2471	0.5563	0.6937	142.880	163.000	234.972
4PL 3 J600	1.2192	0.5283	0.6441	198.680	224.000	347.772
4PL 4 J600	1.2776	0.5207	0.6653	181.440	206.000	309.635
4PL 5 J600	1.2370	0.5207	0.6441	171.460	195.000	302.748
4PL 6 J600	1.2903	0.5080	0.6555	180.530	205.000	312.738

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 P450	1.2700	0.3810	0.4839	153.770	174.000	359.578
5PC 2 P450	1.2598	0.3835	0.4832	153.770	174.000	360.099
5PC 3 P450	1.2878	0.3988	0.5135	153.770	174.000	338.851
5PC 4 P450	1.2929	0.3835	0.4959	154.220	175.000	352.894
5PC 5 P450	1.3005	0.3937	0.5120	152.860	173.000	337.891
5PC 6 P450	1.2954	0.3861	0.5001	146.060	167.000	333.933
5PL 1 P450	1.2573	0.4140	0.5205	150.600	170.000	326.609
5PL 2 P450	1.2649	0.3785	0.4787	168.740	190.000	396.908
5PL 3 P450	1.2954	0.3937	0.5100	154.220	175.000	343.137
5PL 4 P450	1.2852	0.3962	0.5098	172.370	195.000	382.878
5PL 5 P450	1.2827	0.4115	0.5278	199.580	225.000	426.298
5PL 6 P450	1.2878	0.4115	0.5299	154.220	175.000	330.251

TABLE A-1 (CONTINUED

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SCETION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 P600	1.2929	0.4750	0.6141	158.760	179.000	291.483
5PC 2 P600	1.3005	0.4851	0.6309	145.150	166.000	263.116
5PC 3 P600	1.3005	0.4750	0.6177	199.580	225.000	364.254
5PC 4 P600	1.3030	0.4750	0.6189	231.340	261.000	421.716
5PC 5 P600	1.2700	0.4724	0.6000	199.580	225.000	375.000
5PC 6 P600	1.2675	0.4851	0.6149	182.350	207.000	336.640
5PL 1 P600	1.2954	0.4750	0.6153	-	-	-
5PL 2 P600	1.2903	0.4775	0.6162	142.430	163.000	264.525
5PL 3 P600	1.3132	0.4851	0.6371	215.910	247.000	387.694
5PL 4 P600	1.2954	0.4750	0.6153	214.100	246.000	399.805
5PL 5 P600	1.3335	0.4724	0.6300	172.370	195.000	309.524
5PL 6 P600	1.3513	0.4801	0.6487	207.750	237.000	365.346

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 G450	1.2649	0.3886	0.4916	689.470	840.000	1,708.706
5PC 2 G450	1.2497	0.3785	0.4730	552.480	680.000	1,437.632
5PC 3 G450	1.2522	0.4115	0.5153	551.120	679.000	1,317.679
5PC 4 G450	1.2421	0.4216	0.5237	489.890	600.000	1,145.694
5PC 5 G450	1.2573	0.3886	0.4886	616.900	755.000	1,545.231
5PC 6 G450	1.2497	0.3962	0.4952	589.750	736.000	1,486.268
5PL 1 G450	1.2319	0.3962	0.4881	607.820	744.000	1,524.278
5PL 2 G450	1.2319	0.4597	0.5617	654.090	800.000	1,424.248
5PL 3 G450	1.2192	0.4420	0.5388	541.600	666.000	1,236.080
5PL 4 G450	1.2116	0.4089	0.4955	584.240	719.000	1,451.060
5PL 5 G450	1.2116	0.3912	0.4739	576.980	708.000	1,493.986
5PL 6 G450	1.2014	0.3937	0.4730	589.680	736.000	1,556.025

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 G600	1.2700	0.5740	0.7290	721.220	872.000	1,196.159
5PC 2 G600	1.2522	0.5232	0.6552	764.770	919.000	1,402.625
5PC 3 G600	1.2598	0.5182	0.6528	725.760	877.000	1,343.444
5PC 4 G600	1.2598	0.4902	0.6176	717.600	867.000	1.403.821
5PC 5 G600	1.2624	0.5385	0.6798	680.400	825.000	1,213.592
5PC 6 G600	1.2624	0.5969	0.7535	657.720	802.000	1,064.366
5PL 1 G600	1.3411	0.5486	0.7358	868.190	1,020.000	1,386.246
5PL 2 G600	1.3284	0.5283	0.7018	748.440	900.000	1,282.417
5PL 3 G600	1.3106	0.5283	0.6924	791.530	944.000	1,363.374
5PL 4 G600	1.2929	0.5004	0.6469	920.810	1,067.000	1,649.405
5PL 5 G600	1.3081	0.4801	0.6280	851.860	1,002.000	1,595.541
5PL 6 G600	1.2979	0.5715	0.7418	891.780	1,131.000	1,524.670

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CONRRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 J450	1.2446	0.5207	0.6481	285.770	330.000	509.181
5PC 2 J450	1.3970	0.5385	0.7523	340.200	396.000	526.386
5PC 3 J450	1.3970	0.5436	0.7594	301.190	349.000	459.573
5PC 4 J450	1.3894	0.5055	0.7023	369.230	434.000	617.970
5PC 5 J450	1.3792	0.5359	0.7392	362.880	424.000	573.593
5PC 6 J450	1.4021	0.5182	0.7265	399.170	472.000	649.690
5PL 1 J450	1.2116	0.5613	0.6801	172.370	193.000	283.782
5PL 2 J450	1.2217	0.6147	0.7510	155.580	176.000	234.354
5PL 3 J450	1.4046	0.5893	0.8456	179.170	202.000	238.884
5PL 4 J450	1.4072	0.5080	0.7148	191.420	218.000	304.980
5PL 5 J450	1.4199	0.5486	0.7790	190.510	217.000	278.562
5PL 6 J450	1.2700	0.5969	0.7581	145.150	165.000	217.649

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 J600	1.2878	0.6807	0.8766	207.750	235.000	268.081
5PC 2 J600	1.3284	0.6706	0.8908	265.360	300.000	336.776
5PC 3 J600	1.3259	0.6655	0.8823	308.450	355.000	402.357
5PC 4 J600	1.2700	0.6274	0.7968	226.800	259.000	325.050
5PC 5 J600	1.2573	0.6553	0.8239	203.210	230.000	279.160
5PC 6 J600	1.2725	0.7544	0.9600	263.090	300.000	312.500
5PL 1 J600	1.2979	0.7417	0.9627	190.510	216.000	224.369
5PL 2 J600	1.3056	0.7290	0.9517	226.800	259.000	272.145
5PL 3 J600	1.3284	0.6045	0.8031	263.090	300.000	373.552
5PL 4 J600	1.3741	0.6172	0.8481	231.340	262.000	308.926
5PL 5 J600	1.2319	0.6172	0.7604	226.350	259.000	340.610
5PL 6 J600	1.2598	0.6960	0.8768	181.440	206.000	234.945

TABLE A-2 DATA ANL RESULTS OF YOUNG'S MODULUS

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA A cm^2	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
3PC 1 P 450	0.2655	105.871	0.0655	6,087.935		
3PC 2 P 450	0.2634	126.031	0.0770	6,213.999		
3PC 3 P 450	0.2644	120.898	0.0677	6,754.096	6,531.374	375.431
3PC 4 P 450	0.2655	120.897	0.) ¢&&	6,726.112		
3PC 5 P 450	0.2429	107.930	0.0629	7,064.240		
3PC 6 P 450	0.2470	89.757	0.0573	6,341.861		
3PL 1 P 450	0.2650	103.888	0.0516	7,597.517		
3PL 2 P 450	0.2520	100.778	0.0605	6,610.150		
3PL 3 P 450	0.2538	112.881	0.0591	7,525.605	7,342.673	450.209
3PL 4 P 450	0.2518	116.940	0.0613	7,576.091		
3PL 5 P 450	0.2659	100.883	0.0488	7,774.610		
3PL 6 P 450	0.0.2787	110.952	0.0571	6,972.069		

TABLE A- 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
3PC 1 P 600	0.3740	168.285	0.0902	4,988.496		
3PC 2 P 600	0.3390	124.013	0.0450	8,129.339		
3PC 3 P 600	0.3510	128.090	0.0550	6,635.061	6,487.134	1,057.065
3PC 4 P 600	0.3579	134.045	0.0623	6,011.747		
3PC 5 P 600	0.3412	128.201	0.0625	6,143.524		
3PC 6 P 600	0.3536	122.034	0.0492	7,014.637		
3PL 1 P 600	0.3518	123.031	0.0558	6,267.365		
3PL 2 P 600	0.3610	142.138	0.0725	5,430.808		
3PL 3 P 600	0.3587	142.165	0.0646	6,135.210	6,163.377	468.356
3PL 4 P 600	0.3521	144.205	0.0691	5,927.005		
3PL 5 P 600	0.3558	144.220	0.0634	6,393.359		
3PL 6 P 600	0.3634	142.147	0.0573	6,826.518		

TABLE A- 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
3PC 1 G 450	0.2712	422.103	0.0711	21,890.687		
3PC 2 G 450	0.2534	238.084	0.0610	15,402.573		
3PC 3 G 450	0.3089	156.878	0.0406	12,508.855	17,292.941	3,722.024
3PC 4 G 450	0.3208	342.238	0.0508	21,000.554		
3PC 5 G 450	0.3115	115.673	0.0203	18,292.766		
3PC 6 G 450	0.2719	405.044	0.1016	14,662.218		
3PL 1 G 450	0.3187	392.722	0.0711	17,331.400		
3PL 2 G 450	0.3244	390.651	0.0813	14,812.146		
3PL 3 G 450	0.3107	-	-	-		
3PL 4 G 450	0.2885	209.315	0.0406	17,870.139	16,502.245	1,492.938
3PL 5 G 450	0.2979	318.866	0.0610	17,547.188		
3PL 6 G 450	0.3057	417.728	0.0914	14,950.354		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS ($kg.cm^2$)	ESTIMATED STANDARD DEVIATION
3PC 1 G 600	0.3789	117.557	0.0203	15,283.624		
3PC 2 G 600	0.4387	66.351	0.0102	14,[illegible]28.009		
3PC 3 G 600	0.3896	570.729	0.0914	16,027.470	15,109.849	1,780.313
3PC 4 G 600	0.3564	615.412	0.1118	15,444.959		
3PC 5 G 600	0.3896	408.658	0.0610	17,195.360		
3PC 6 G 600	0.4498	1,260.560	0.1727	16,227.502		
3PL 1 G 600	0.3427	789.290	0.1016	22,668.823		
3PL 2 G 600	0.3531	752.421	0.1118	19,059.923		
3PL 3 G 600	0.3700	[illegible]7.543	0.0102	23,196.267	20,116.309	2,572.421
3PL 4 G 600	0.3730	703.187	0.0914	20,626.051		
3PL 5 G 600	0.3857	808.593	0.1118	18,751.608		
3PL 6 G 600	0.4847	565.014	0.0711	16,395.194		

TABLE A - 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
3PC 1 J 450	0.4256	134.369	0.0813	5,617.381		
3PC 2 J 450	0.4080	154.689	0.0610	6,215.390		
3PC 3 J 450	0.4520	92.760	0.0305	6,728.580	6,606.927	833.688
3PC 4 J 450	0.4545	133.287	0.0406	7,223.187		
3PC 5 J 450	0.5037	92.107	0.0305	5,995.442		
3PC 6 J 450	0.4283	132.697	0.0305	7,861.583		
3PL 1 J 450	0.4226	245.778	0.0711	8,179.810		
3PL 2 J 450	0.4448	212.332	0.0610	7,825.674		
3PL 3 J 450	0.4219	331.240	0.1118	7,022.503	8,031.843	591.512
3PL 4 J 450	0.4334	71.061	0.0203	8,076.960		
3PL 5 J 450	0.4632	233.870	0.0610	8,277.073		
3PL 6 J 450	0.5010	134.607	0.0305	8,809.039		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E ($kg.cm^2$)	AVERAGE YOUNG'S MODULUS ($kg.cm^2$)	ESTIMATED STANDARD DEVIATION
3PC 1 J 600	0.5070	113.619	0.0305	7,347.553		
3PC 2 J 600	0.5335	173.997	0.406	8,033.086		
3PC 3 J 600	0.5062	132.780	0.0305	8,600.233	8,393.168	599.293
3PC 4 J 600	0.5017	134.124	0.0305	8,765.188		
3PC 5 J 600	0.5167	235.298	0.0508	8,964.298		
3PC 6 J 600	0.5462	191.790	0.0406	8,648.653		
3PL 1 J 600	0.5277	82.740	0.0203	7,723.827		
3PL 2 J 600	0.5243	70.516	0.0203	6,625.393		
3PL 3 J 600	0.5094	110.993	0.0305	7,143.909	6,899.042	586.209
3PL 4 J 600	0.5274	314.602	0.0914	6,526.412		
3PL 5 J 600	0.5423	134.453	0.0406	6,106.655		
3PL 6 J 600	0.5359	316.660	0.0813	7,268.059		

TABLE A - 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CONIRECTED LOAD (kg)	INCREMENT STRAIN AE	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
4PC 1 P 450	0.3503	349.832	0.1118	8,932.583		
4PC 2 P 450	0.3485	124.422	0.0406	8,793.666		
4PC 3 P 450	0.3929	260.448	0.0813	8,153.593	8,704.210	312.445
4PC 4 P 450	0.3685	132.041	0.0406	8,825.590		
4PC 5 P 450	0.3515	-	-	-		
4PC 6 P 450	0.3733	133.609	0.0406	8,815.617		
4PL 1 P 450	0.3308	62.431	0.0203	9,296.871		
4PL 2 P 450	0.3548	102.517	0.0508	5,687.871		
4PL 3 P 450	0.3739	135.958	0.0610	5,960.983	6,866.347	1,433.013
4PL 4 P 450	0.3406	-	-	-		
4PL 5 P 450	0.3692	122.943	0.0508	6,555.073		
4PL 6 P 450	0.3671	152.966	0.0610	6,830.941		

TBLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN ΔE	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
4PC 1 P 600	0.5495	266.223	0.0711	5,814.091		
4PC 2 P 600	0.5376	102.751	0.0305	6,266.500		
4PC 3 P 600	0.5473	72.536	0.0203	6,528.813	5,919.141	735.600
4PC 4 P 600	0.5322	61.756	0.0203	5,716.185		
4PC 5 P 600	0.5548	174.973	0.0610	5,170.155		
4PC 6 P 600	0.5020	102.295	0.0406	5,019.104		
4PL 1 P 600	0.4730	113.237	0.0508	4,712.651		
4PL 2 P 600	0.4647	101.167	0.0406	5,362.144		
4PL 3 P 600	0.5165	82.018	0.0305	5,206.444	5,320.608	432.727
4PL 4 P 600	0.4503	103.228	0.0406	5,646.395		
4PL 5 P 600	0.5606	144.116	0.0508	5,060.513		
4PL 6 P 600	0.5126	31.034	0.0102	5,935.501		

TABLE A - 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT COTRICTED LOAD (kg)	INCREMENT STRAIN AE	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
4PC 1 G 450	0.3956	75.564	0.0102	18,726.650		
4PC 2 G 450	0.3554	359.629	0.0508	19,919.255		
4PC 3 G 450	0.4488	633.672	0.1016	13,896.906	16,062.034	2,680.470
4PC 4 G 450	0.3950	538.763	0.1016	13,424.761		
4PC 5 G 450	0.3917	630.560	0.1016	15,844.517		
4PC 6 G 450	0.4110	607.996	0.1016	14,560.125		
4PL 1 G 450	0.3904	636.713	0.1016	17,312.968		
4PL 2 G 450	0.4179	672.411	0.1016	15,466.738		
4PL 3 G 450	0.3841	65.766	0.0102	16,786.386	16,289.159	906.450
4PL 4 G 450	0.4175	280.358	0.0406	16,539.813		
4PL 5 G 450	0.4273	65.001	0.0102	14,913.776		
4PL 6 G 450	0.3629	678.176	0.1118	16,715.281		

TABLE A- 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULDS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
4PC 1 G 600	0.5065	644.496	0.0813	15,651.284		
4PC 2 G 600	0.5548	802.108	0.0914	15,817.954		
4PC 3 G 600	0.6194	256.246	0.0305	13,563.943	15,254.395	868.129
4PC 4 G 600	0.5698	446.717	0.0508	15,432.855		
4PC 5 G 600	0.5440	167.589	0.0203	15,175.750		
4PC 6 G 600	0.5932	478.675	0.0508	15,884.596		
4PL 1 G 600	0.5495	99.217	0.0102	17,701.783		
4PL 2 G 600	0.5333	967.756	0.0914	19,853.994		
4PL 3 G 600	0.5006	297.019	0.0305	19,453.280	20,144.760	1,806.028
4PL 4 G 600	0.5194	713.678	0.0711	19,325.503		
4PL 5 G 600	0.5450	747.548	0.0610	22,489.025		
4PL 6 G 600	0.4960	111.530	0.0102	22,044.982		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN $\Delta\epsilon$	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
4PC 1 J 450	0.5555	196.462	0.0914	3,869.447		
4PC 2 J 450	0.5348	114.150	0.0610	3,499.087		
4PC 3 J 450	0.6714	186.855	0.0813	3,423.196		
4PC 4 J 450	0.6090	352.683	0.1626	3,561.610	3,730.974	331.513
4PC 5 J 450	0.6090	206.381	0.0914	3,707.718		
4PC 6 J 450	0.5609	197.215	0.0813	4,324.788		
4PL 1 J 450	0.6032	167.515	0.0711	3,905.924		
4PL 2 J 450	0.5940	134.778	0.0711	3,191.270		
4PL 3 J 450	0.5817	187.710	0.1016	3,176.105		
4PL 4 J 450	0.6063	82.919	0.0406	3,368.526	3,347.915	288.726
4PL 5 J 450	0.6154	214.914	0.1118	3,123.677		
4PL 6 J 450	0.5791	234.507	0.1219	3,321.990		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORESSED LOAD (kg/cm^2)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
4PC 1 J 600	0.6696	143.204	0.0508	4,209.930		
4PC 2 J 600	0.7340	259.837	0.0914	3,873.097		
4PC 3 J 600	0.7286	281.524	0.0813	4,752.655		
4PC 4 J 600	0.7476	250.661	0.0711	4,715.716	4,295.539	3,62.574
4PC 5 J 600	0.7243	185.803	0.0610	4,205.364		
4PC 6 J 600	0.7542	122.987	0.0406	4,016.474		
4Pl 1 J 600	0.6790	93.376	0.0508	2,707.075		
4PL 2 J 600	0.6937	196.553	0.0914	3,100.002		
4PL 3 J 600	0.6441	143.153	0.0711	3,125.914		
4PL 4 J 600	0.6653	133.987	0.0610	3,301.530	3,195.912	288.848
4PL 5 J 600	0.6441	206.259	0.0914	3,503.583		
4PL 6 J 600	0.6555	205.942	0.0914	3,437.366		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA A (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
5Pc 1 P 450	0.4839	195.043	0.0508	7,934.363		
5PC 2 P 450	0.4832	256.564	0.0711	7,467.910		
5PC 3 P 450	0.5135	164.085	0.0406	7,870.523	7,685.180	445.087
5Pc 4 P 450	0.4959	123.613	0.0305	8,172.777		
5PC 5 P 450	0.5120	143.599	0.0406	6,908.070		
5PC 6 P 450	0.5001	197.078	0.0508	7,757.439		
5PL 1 P 450	0.5205	194.571	0.0508	7,358.567		
5PL 2 P 450	0.4787	286.089	0.0813	7,351.003		
5PL 3 P 450	0.5100	257.421	0.0813	6,208.456	6,953.483	780.945
5PL 4 P 450	0.5093	153.793	0.0406	7,437.671		
5PL 5 P 450	0.5278	122.809	0.0305	7,628.910		
5PL 6 P 450	0.5299	61.705	0.0203	5,736.290		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (Cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (Kg/Cm^2)	AVERAGE YOUNG'S MODULUS (Kg/Cm^2)	ESTIMATED STANDARD DEVIATION
5PC 1 P 600	0.6141	184.061	0.0711	4,215.545		
5PC 2 P 600	0.6309	217.930	0.0813	4,248.800		
5PC 3 P 600	0.6177	398.757	0.1422	4,539.739	4,349.464	343.422
5PC 4 P 600	0.6189	265.995	0.0914	4,702.259		
5PC 5 P 600	0.6000	184.139	0.0813	3,774.880		
5PC 6 P 600	0.6149	288.352	0.1016	4,615.561		
5PL 1 P 600	0.6153	-	-	-		
5PL 2 P 600	0.6162	30[illegible].189	0.1118	4,371.960		
5PL 3 P 600	0.6371	301.077	0.1118	4,226.962	4,149.919	249.063
5PL 4 P 600	0.6153	218.950	0.0813	4,376.906		
5PL 5 P 600	0.6300	123.156	0.0508	3,848.133		
5PL6 P 600	0.6487	155.340	0.0610	3,925.634		

TABLE A - 2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA A (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
5PC 1 G 450	0.4916	209.792	0.0203	21,022.385		
5PC 2 G 450	0.4730	178,478	0.0203	18,587.782		
5PC 3 G 450	0.5153	871.803	0.1016	16,651.924	18,468.096	1,758.673
5PC 4 G 450	0.5237	89.238	0.0102	16,705.769		
5PC 5 G 450	0.4886	89.172	0.0102	17,892.667		
5PC 6 G 450	0.4952	100.758	0.010	19,948.053		
5PL 1 G 450	0.4881	177.497	0.0203	17,913.707		
5PL 2 G 450	0.5617	210.610	0.0203	18,470.473		
5PL 3 G 450	0.5388	189.460	0.0203	17,321.811	18,384.881	970.452
5PL 4 G 450	0.4955	189.609	0.0203	18,850.343		
5PL 5 G 450	0.4739	256.204	0.0305	17,725.509		
5PL 6 G 450	0.4730	192.302	0.0203	20,027.447		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION ARE A	INCREMENT CORRECTED LOAD kg)	INCREMENT STRAIN	YOUNG'S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm)	ESTIMATED STANDARD DEVIATION
5PC 1 G 600	0.7290	99.106	0.0102	13,328.156		
5PC 2 G 600	0.6552	109.444	0.0102	16,376.351		
5PC 3 G 600	0.6528	208.081	0.0203	15,702.050	15,130.692	1,293.743
5PC 4 G 600	0.6176	208.048	0.0203	16,594.317		
5PC 5 G 600	0.6798	99.389	0.0102	14,333.669		
5PC 6 G 600	0.7535	111.055	0.0102	14,449.620		
5PL 1 G 600	0.7358	223.603	0.0203	14,969.982		
5PL 2 G 600	0.7018	109.520	0.0102	15,299.546		
5PL 3 G 600	0.6924	119.482	0.0102	16,917.906	16,661.719	1,317.500
5PL 4 G 600	0.6469	116.090	0.0102	17,593.663		
5PL 5 G 600	0.6280	117.842	0.0102	18,396.656		
5PL 6 G 600	0.7418	127.059	0.0102	16,792.568		

TABLE A-2 (CONTINUED)

TYPE OF TESTED SPECIMENS	CROSS SECTION AREA (cm^2)	INCREMENT CORRECTED LOAD (kg)	INCREMENT STRAIN	YOUNG"S MODULUS E (kg/cm^2)	AVERAGE YOUNG'S MODULUS (kg/cm^2)	ESTIMATED STANDARD DEVIATION
5PC 1 J 450	0.6481	272.377	0.1016	4,136.519		
5PC 2 J 450	0.7523	390.717	0.1524	3,407.899		
5PC 3 J 450	0.7594	231.163	0.0914	3,330.434	3,733.350	365.691
5PC 4 J 450	0.7023	127.960	0.0508	3,586.640		
5PC 5 J 450	0.7392	561.796	0.2032	3,740.186		
5PC 6 J 450	0.7265	278.784	0.0914	4,198.418		
5PL 1 J 450	0.6801	101.577	0.0508	2,940.081		
5PL 2 J 450	0.7510	236.041	0.1016	3,093.522		
5PL 3 J 450	0.8456	153.519	0.0610	2,976.237	3,074.868	146.052
5PL 4 J 450	0.7148	289.238	0.1219	3,319.463		
5PL 5 J 450	0.7790	299.619	0.1219	3,155.206		
5PL 6 J 450	0.7581	319.600	0.1422	2,964.698		

TABLE A-1 (CONTINUED)

TYPE OF TESTED SPECIMENS	WIDTH OF NARROW SECTION W cm	THICKNESS T cm	CROSS SECTION AREA cm^2	INDICATED LOAD kg	CORRECTED LOAD kg	TENSILE STRENGTH kg/cm^2
5PC 1 J600	1.2878	0.6807	0.8766	207.750	235.000	268.081
5PC 2 J600	1.3284	0.6706	0.8908	265.360	300.000	336.776
5PC 3 J600	1.3259	0.6655	0.8823	308.450	355.000	402.357
5PC 4 J600	1.2700	0.6274	0.7968	226.800	259.000	325.050
5PC 5 J600	1.2573	0.6553	0.8239	203.210	230.000	279.160
5PC 6 J600	1.2725	0.7544	0.9600	263.090	300.000	312.500
5PL 1 J600	1.2979	0.7417	0.9627	190.510	216.000	224.369
5PL 2 J600	1.3056	0.7290	0.9517	226.800	259.000	272.145
5PL 3 J600	1.3284	0.6045	0.8031	263.090	300.000	373.552
5PL 4 J600	1.3741	0.6172	0.8481	231.340	262.000	308.926
5PL 5 J600	1.2319	0.6172	0.7604	226.350	259.000	340.610
5PL 6 J600	1.2598	0.6960	0.8768	181.440	206.000	234.945

TABLE A - 3 DATA AND RESULTS OF FLEXURAL PROPERTIES

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d cm	WIDTH OF BEAM TESTED b cm	SPAN L cm	LOAD P kg	SLOPE M kg cm	FLEXURAL STRENGTH kg cm^2	FLEXURAL MODULUS kg cm^2
3PC 1 P 450	0.2108	2.4968	2.50	10.691	118.987	361.347	19,873.025
3PC 2 P 450	0.2032	2.5400	2.50	15.806	105.317	565.161	19,304.283
3PC 3 P 450	0.2134	2.5070	2.50	17.435	118.443	572.677	18,990.301
3PC 4 P 450	0.2134	2.5019	2.50	28.362	116.843	933.489	18,771.956
3PC 5 P 450	0.1930	2.4638	2.50	27.901	101.121	1,140.069	22,300.983
3PC 6 P 450	0.2083	0.5298	2.50	12.556	115.351	428.961	19.707.312
3PL 1 P 450	0.1981	2.5197	2.50	17.671	104.008	670.154	20,740.753
3PL 2 P 450	0.2032	2.5451	2.50	27.901	108.243	995.632	19,800.853
3PL 3 P 450	0.1930	2.5070	2.50	28.362	98.726	1,138.936	21.397.612
3PL 4 P 450	0.1930	2.4714	2.50	13.950	88.480	568.261	19,453.161
3PL 5 P 450	0.2057	2.5375	2.50	18.829	91.525	657.633	16,187.912
3PL 6 P 450	0.2108	2.4994	2.50	23.708	103.078	800.478	17,198.019

TABLE A - 3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (kg.)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
3PC 1 P 600	0.2870	2.5146.	4.00	29.992	81.579	868.808	21,957.544
3PC 2 P 600	0.2794	2.5298	4.00	22.786	78.456	693.649	22,749.966
3PC 3 P 600	0.2896	2,5248	4.00	36.265	81.633	1,027.578	21,299.189
3PC 4 P 600	0.2870	2.5222	4.00	34.635	81.169	1,000.284	21,781.359
3PC 5 P 600	0.2794	2.5705	4.00	22.089	84.027	660.476	23,979.605
3PC 6 P 600	0.2794	2.5479	4.00	22.786	79.847	687.141	22,991.544
3PL 1 P 600	0.2743	2.5400	4.00	22.786	73.223	715.375	21,147.283
3PL 2 P 600	0.2819	2.5273	4.00	24.641	73.223	736.144	20,693.096
3PL 3 P 600	0.2921	2.5070	4.00	23.247	80.083	652.080	20,507.433
3PL 4 P 600	0.2946	2.5349	4.00	25.388	81.893	691.031	20,216.581
3PL 5 P 600	0.2819	2.5400	4.00	29.756	77.334	884.508	21,745.606
3P1 6 P 600	0.2794	2.5349	4.00	30.689	79.681	930.589	23,058.694

TABLE A - 3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (kg)	SLOPE m kg/cm)	FLEXURAL STRENGTH S kg/cm)	FLEXURAL MODULUS E_B kg/cm)^2
3Pc 1 G 450	0.2286	2.5019	2.50	87.412	183.050	2,507.148	23,923.853
3PC 2 G 450	0.2032	2.5222	2.50	63.468	155.788	2,285.384	28,756.988
3PC 3 G 450	0.2134	2.5476	2.50	77.644	147.956	2,396.087	21,777.272
3PC 4 G 450	0.2489	0.5527	2.50	113.090	146.441	2,800.237	14,532.765
3PC 5 G 450	0.2642	2.5222	2.50	102.982	191.018	2,193.550	16,041.921
3PC 6 G 450	0.2184	2.5349	2.50	79.038	167.034	2,451.326	24,708.488
3PL 1 G 450	0.2311	2.5273	2.50	83.456	146.441	2,318.634	18,338.596
3PL 2 G 450	0.2540	2.4155	2.50	88.806	155.931	2,136.973	15,388.075
3PL 3 G 450	0.2159	2.5476	2.50	90.200	145.248	2,848.402	22,129.980
3PL 4 G 450	0.2413	2.5019	2.50	101.824	172.589	2,621.180	19.179.233
3PL 5 G 450	0.2413	2.4943	2.50	88.335	152.541	2,280.871	17,003.015
3PL 6 G 450	0.2362	2.5019	2.50	64.626	169.242	1,436.236	20,052.040

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENT	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B $Kg/cm^2)$
3PC 1 G 600	0.2946	2.5629	4.00	71.135	151.897	1,918.834	37,088.502
3PC 2 G 600	0.3124	2.5629	4.00	85.321	171.621	2,046.697	35,141.935
3PC 3 G 600	0.3200	2.5527	4.00	82.062	155.598	1,883621	29,762.834
3PC 4 G 600	0.2921	2.5349	4.00	81.826	143.008	2,269.962	36,218.029
3PC 5 G 600	0.3505	2.5527	4.00	96.709	137.882	1,850.301	20,070.755
3PC 6 G 600	0.3607	2.5629	4.00	88.335	159.757	1,589.499	21,252.489
3PL 1 G 600	0.2743	2.5298	4.00	81.365	139.125	2,564.786	42,634.537
3PL 2 G 600	0.2870	2.5146	4.00	86.479	144.519	2,505.124	33,898.274
3PL 3 G 600	0.2845	2.5375	4.00	91.502	151.494	2,673.076	41,482.273
3PL 4 G 600	0.2946	2.5324	4.00	84.624	146.441	2,310.186	36,186.963
3PL 5 G 600	0.3073	2.5171	4.00	98.195	142.590	2,478.649	31,233.517
3PL 6 G 600	0.3810	2.5476	4.00	120.653	132.207	1,957.529	15,013.027

TABLE A- 3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b(cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
3PC 1 J 450	0.3302	2.5476	4.00	39.524	128.134	853.742	22,352.284
3PC 2 J 450	0.3581	2.5451	4.00	39.585	129.542	735.080	17,734.247
3PC 3 J 450	0.3404	2.5425	4.00	36.500	129.970	743.368	20,736.406
3PC 4 J 450	0.3480	2.5603	4.00	38.028	109.830	735.877	16,285.923
3PC 5 J 450	0.3937	2.5375	4.00	46.494	120.067	709.269	12,406.273
3PC 6 J 450	0.3556	2.5248	4.00	38.591	121.274	725.248	17,091.314
3PL 1 J 450	0.3480	2.5603	4.00	26.035	110.524	503.802	16,388.831
3PL 2 J 450	0.3505	2.4765	4.00	25.102	118.224	495.046	17,738.759
3PL 3 J 450	0.3226	2.5298	4.00	21.392	107.680	487.515	20.285.034
3PL 4 J 450	0.3327	2.5654	4.00	21.155	111.863	446.996	18,944.928
3PL 5 J 450	0.3886	2.5197	4.00	26.595	122.033	419.369	13,205.050
3PL 6 J 450	0.3886	2.5222	4.00	26.502	136.605	417.489	14,767.217

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
3PC 1 J 600	0.4166	2.5070	5.00	33.429	113.161	576.225	19,508.985
3PC 2 J 600	0.4343	2.5730	5.00	32.081	120.646	495.781	17,887.666
3PC 3 J 600	0.4166	2.5552	5.00	30.221	114.411	511.101	19.352,412
3PC 4 J 600	0.4216	2.5273	5.00	33.662	115.931	562.009	19.128.944
3PC 5 J 600	0.4216	2.5578	5.00	33.476	109.830	552.239	17,906.166
3PC 6 J 600	0.4394	2.5273	5.00	39.055	122.911	600.290	17,914.464
3PL 1 J 600	0.4080	2.5578	5.00	25.246	108.725	444.700	19,558.357
3PL 2 J 600	0.3912	2.5375	5.00	24.735	95.886	477.716	19.724.347
3PL 3 J 600	0.4166	2.5375	5.00	28.594	106.555	486.958	18,149.305
3PL 4 J 600	0.4166	2.5324	5.00	27.431	102.794	468.093	17,543.962
3PL 5 J 600	0.4394	2.5095	5.00	30.221	120.817	467.803	17,734.163
3PL 6 J 600	0.4293	2.4816	5.00	32.313	119.814	529.889	19,069.668

TABLE A - 3 (CONTINUED)

TYPE of TESTED SPECIMENS	DEPTH of BEAM TESTED d (cm)	WIDTH of BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
4PC 1 P 450	0.2845	2.5349	4.00	19.063	81.900	557.464	22,448.960
4PC 2 P 450	0.2845	2.5425	4.00	24.177	83.570	704.901	22,038.239
4PC 3 P 450	0.2946	2.5273	4.00	22.317	87.070	610.471	21,559.243
4PC 4 P 450	0.2921	2.4765	4.00	28.826	85.624	818.529	22,196.397
4PC 5 P 450	0.2743	2.5197	4.00	15.808	75.205	500.297	23,138.779
4PC 6 P 450	0.2794	2.5171	4.00	28.361	74.003	866.003	21,566.994
4PL 1 P 450	0.2692	2.5375	4.00	25.107	73.659	819.200	23,807.543
4PL 2 P 450	0.2870	2.5451	4.00	19.063	81.169	545.599	21,585.377
4PL 3 P 450	0.2997	2.5603	4.00	23.015	80.263	600.479	18,633.064
4PL 4 P 450	0.2743	2.5375	4.00	19.295	77.557	606.371	23,698.099
4PL 5 P 450	0.2896	2.5273	4.00	19.620	75.279	555.388	19,621.913
4PL 6 P 450	0.2896	2.5349	4.00	26.967	79.510	761.072	20.662.612

TABLE A - 3 (CONTINUED)

TYPE of TESTED SPECIMENS	DEPTH of BEAM TESTED d (cm)	WIDTH of BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
4PC 1 P 600	0.4242	2.4765	5.00	49.749	99.602	837.271	16,465.228
4PC 2 P 600	0.4115	2.5248	5.00	44.634	104.948	782.998	18,641.793
4PC 3 P 600	0.4140	2.5400	5.00	53.003	10[illegible].205	913.153	17,720.967
4PC 4 P 600	0.4039	2.5095	5.00	40.450	101.[illegible]30	741.046	19,263.859
4PC 5 P 600	0.4267	2.5121	5.00	52.073	96.[illegible]52	853.870	15,507.927
4PC 6 P 600	0.4064	2.5222	5.00	39.520	93.397	711.527	17,240.201
4PL 1 P 600	0,3861	2.5552	5.00	34.406	96.348	677.440	20,472.384
4PL 2 P 600	0.3683	2.5222	5.00	38.125	86.8[illegible]1	835.773	21,539.725
4PL 3 P 600	0.3658	2,5400	5.00	32.546	93.058	733.835	23,390.468
4PL 4 P 600	0.3632	2.5654	5.00	39.985	8[illegible].246	886.159	22,436.362
4PL 5 P 600	0.4039	2.5273	5.00	48.354	95.193	879.608	17,863.916
4PL 6 P 600	0.3658	2.5705	5.00	31.151	98.406	679.248	24,441.220

TABLE A - 3 (CONTINUED)

TYPE of TESTED SPECIMENS	DEPTH of BEAM TESTED d (cm)	WIDTH of BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm²)	FLEXURAL MODLUS E_B (kg/cm²)
4PC 1 G 450	0.3124	2.5527	4.00	80.202	162.710	1,931.589	33,450.404
4PC 2 G 450	0.2921	2.5578	4.00	84.613	154.269	2,326.427	38,720.182
4PC 3 G 450	0.3632	2.5502	4.00	106.936	177.418	1,907.257	23,233.032
4PC 4 G 450	0,3353	2.5451	4.00	104.147	183.050	2,183.866	30,527.005
4PC 5 G 450	0.3327	2.5603	4.00	106.306	176.947	2,244.322	30,027.137
4PC 6 G 450	0.3531	2.5552	4.00	93.220	170.847	1,755.658	24,300.169
4PL 1 G 450	0.2972	2.5832	4.00	94.150	166.778	2,475.802	39,350.866
4PL 2 G 450	0.3251	2.5527	4.00	113.678	187.515	2,528.098	34,206.237
4PL 3 G 450	0.3200	2.5248	4.00	97.172	168.407	2,255.098	32,568.909
4PL 4 G 450	0.3327	2.5222	4.00	120.884	163,578	2,597.975	28,177.791
4PL 5 G 450	0.3378	2.5248	4.00	101..357	163.781	2,110.857	26,926.356
4PL 6 G 450	0.2870	2.5375	4.00	77.645	139.026	2,228.922	37,082.095

TABLE A - 3 (CONTINUED)

TYPE of TESTED SPECIMENS	DEPTH of BEAM TESTED d (cm)	WIDTH of BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
4PC 1 G 600	0.4267	2.5679	5.00	121.814	172.286	1,954.047	26,986.960
4PC 2 G 600	0.3988	2.5832	5.00	111.818	163.348	2,041.290	31,155.904
4PC 3 G 600	0.4775	2.5883	5.00	130.881	183.050	1,663.323	20,299.484
4PC 4 G 600	0.4521	2.5857	5.00	124.836	177.154	1,771.552	23,169.642
4PC 5 G 600	0.4470	2.5781	5.00	135.669	175.741	1,975.273	23,850.681
4PC 6 G 600	0.4674	2.5654	5.00	132.973	172.082	1,779.476	20,624.269
4PL 1 G 600	0.4280	2.5578	5.00	127.394	161.661	2,039.183	25,191.695
4PL 2 G 600	0.4343	2.5603	5.00	134.833	161.661	2,094.050	24,087.678
4PL 3 G 600	0.4115	2.5578	5.00	135.530	166.953	2,346.878	29,273.061
4PL 4 G 600	0.4115	2.5603	5.00	120.884	162.713	2,091.219	28,501.774
4PL 5 G 600	0.4470	2.5806	5.00	136.227	162.713	1,981.476	22,061.194
4PL 6 G 600	0.4445	2.5578	5.00	134.833	161.802	2,001.001	22,508.784

TABLE A - 3 (CONTINUED)

TYPE of TESTED SPECIMENS	DEPTH of BEAM TESTED d (cm)	WIDTH of BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
4PC 1 J 450	0.4623	2.5527	5.00	59.977	159.322	824.515	19,740.325
4PC 2 J 450	0.4470	2.5629	5.00	56.955	149.763	834.154	20,446.304
4PC 3 J 450	0.5537	2.5629	5.00	76.250	168.970	750.448	12,136.806
4PC 4 J 450	0.4928	2.5667	5.00	69.741	166.409	839.137	16,929.324
4PC 5 J 450	0.5359	2.4460	5.00	56.909	161.514	607.601	13,407.644
4PC 6 J 450	0.4915	2.4994	5.00	59.745	155.591	742.130	16,384.310
4PL 1 J 450	0.4712	2.5400	5.00	28.129	123.359	347.086	14,506.789
4PL 2 J 450	0.4750	2.5095	5.00	33.476	120.032	443.425	13,946.943
4PL 3 J 450	0.4788	2.5806	5.00	36.265	122.035	459.748	13,463.073
4PL 4 J 450	0.4750	2.5832	5.00	37.195	116.079	478.631	13,102.821
4PL 5 J 450	0.4724	2.5756	5.00	33.476	119.382	436.814	13,808.866
4PL 6 J 450	0.4597	2.5781	5.00	31.290	104.300	430.743	13,051.440

TYPE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
4PC 1 J600	0.5334	1.3729	8.00	12.553	29.933	385.642	18,389.176
4PC 2 J600	0.5817	1.3830	8.00	21.045	60.489	562.725	28,442.450
4PC 3 J600	0.5334	1.3818	8.00	18.598	49.114	567.670	29,978.579
4PC 4 J600	0.5486	1.3792	8.00	16.366	51.419	473.135	28,902.735
4PC 5 J600	0.5690	1.3741	8.00	14.506	41.427	391.279	20,947.795
4PC 6 J600	0.5715	1.3792	8.00	17.761	46.038	473.139	22,890.246
4PL 1 J600	0.5563	1.3665	8.00	12.321	25.190	349.623	13,705.703
4PL 2 J600	0.5563	1.3665	8.00	12.646	43.476	358.845	23,654.988
4PL 3 J600	0.5258	1.3564	8.00	14.413	45.977	461.218	29,847.027
4PL 4 J600	0.5258	1.3665	8.00	13.483	35.957	424.226	22,842.411
4PL 5 J600	0.5144	1.3716	8.00	17.854	42.792	590.320	29,338.790
4PL 6 J600	0.5321	1.3716	8.00	18.365	45.409	567.490	28,128.376

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLESURAL MODULUS E_B (kg/cm^2)
5PC 1 P450	0.3912	2.5260	5.00	27.431	61.652	532.196	12,739.937
5PC 2 P450	0.3708	2.5235	5.00	35.335	85.106	763.807	20,672.248
5PC 3 P450	0.4242	2.5298	5.00	39.985	94.591	658.766	15,305.789
5PC 4 P450	0.3708	2.4994	5.00	41.380	86.296	903.101	21,163.415
5PC 5 P450	0.3886	2.5121	5.00	37.660	93.015	744.559	19,717.765
5PC 6 P450	0.3962	2.5083	5.00	29.756	83.209	566.797	16,651.938
5PL 1 P450	0.4064	2.5108	5.00	12.088	93.084	-	17,260.439
5PL 2 P450	0.3670	2.5019	5.00	43.704	74.372	972.703	18,792.793
5PL 3 P450	0.3835	2.4816	5.00	36.730	71.834	754.779	16,038.073
5PL 4 P450	0.4013	2.4613	5.00	41.845	69.372	791.775	13,628.944
5PL 5 P450	0.4255	2.4994	5.00	36.265	78.456	601.055	12,733.322
5PL 6 P450	0.4077	2.5273	5.00	37.195	76.272	664.060	13,916.699

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d(cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S) kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
5PC 1 P600	0.4699	1.3513	8.00	14.646	30.150	589.030	27,525.117
5PC 2 P600	0.4440	1.3170	8.00	24,874	33.068	1,149.675	36,718.355
5PC 3 P600	0.4737	1.3195	8.00	23.247	31.599	942.176	28,837.908
5PC 4 P600	0.4775	1.3272	8.00	20.457	32.034	811.223	28,376.880
5PC 5 P600	0.4699	1.3678	8.00	17.947	31.411	713.082	28,330.406
5PC 6 P600	0.4877	1.3094	8.00	24.177	33.692	931.549	28,392.665
5PL 1 P600	0.4750	1.3246	8.00	13.948	30.742	560.043	27,718.933
5PL 2 P600	0.4712	1.3233	8.00	14.878	29.886	607.655	27,631.445
5PL 3 P600	0.4826	1.3119	8.00	18.598	29.143	730.419	25,297.729
5PL 4 P600	0.4750	1.3272	8.00	17.900	30.321	717.316	27,285.774
5PL 5 P600	0.4699	1.3360	8.00	24.177	29.497	983.482	27,237.361
5PL 6 P600	0.4750	1.3030	8.00	13.948	29.492	569.327	27,032.670

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLESURAL MODULUS E_B (kg/cm^2)
5PC 1 G 450	0.3874	2.5578	5.00	109.261	154.890	2,134.719	32,548.274
5PC 2 G450	0.3937	2.5171	5.00	116.839	153.165	2,246.042	31,161.104
5PC 3 G450	0.4242	2.5603	5.00	107.866	157.463	1,755.956	25,178.258
5PC 4 G450	0.4318	2.4943	5.00	125.069	158.750	2,016.959	24,703.993
5PC 5 G450	0.3899	2.5679	5.00	116.142	154.285	2,231.341	31,676.406
5PC 6 G450	0.3937	2.5029	5.00	115.398	148.054	2,178.698	29,583.003
5PL 1 G450	0.4178	2.5819	5.00	135.762	162.483	2,259.244	26,965.795
5PL 2 G450	0.4547	2.5883	5.00	122.279	156.009	1,713.755	20,035.962
5PL 3 G450	0.4559	2.5908	5.00	135,995	167.794	2,142.189	21,359.141
5PL 4 G450	0.3968	2.5921	5.00	114.375	153.525	2,080.800	29,181.790
5PL 5 G450	0.3937	2.5705	5.00	117.862	146.005	2,218.639	29,087.333
5PL 6 G450	0.4001	2.5730	5.00	117.397	150.362	2,137.674	28,512.984

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS (kg/cm^2)
5PC 1 G600	0.5906	1.4021	8.00	68.439	83.480	1,679.264	39,209.903
5PC 2 G600	0.5207	1.3957	8.00	62.999	81.606	1,997.780	53,012.373
5PC 3 G600	0.5423	1.3856	8.00	53.468	81.360	1,574.556	47,126.394
5PC 4 G600	0.4928	1.3602	8.00	52.538	72.438	1,908.581	56,958.894
5PC 5 G600	0.5309	1.4148	8.00	59.047	78.715	1.776.882	41,210.400
5PC 6 G600	0.6134	1.3526	8.00	59.977	89.767	1,414.104	36,806.623
5PL 1 G600	0.5486	1.3919	8.00	57.835	89.590	1,658.165	49,899.255
5PL 2 G600	0.5309	1.3843	8.00	64.627	85.653	1,987.648	52,927.837
5PL 3 G600	0.5156	1.3640	8.00	57.138	75.988	1,892.544	52,023.778
5PL 4 G600	0.5055	1.3780	8.00	71.368	75.877	2,432.166	56,721.493
5PL 5 G600	0.4801	1.3716	8.00	56.955	73.866	2,161.833	62,291.954
5PL 6 G600	0.5550	1.3526	8.00	64.627	75.148	1,861.401	41,598.633

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
5PC 1 J450	0.5207	1.3195	8.00	17.668	49.515	592.631	34,023.158
5PC 2 J 450	0.5436	1.3487	8.00	22.410	53.510	674.759	31,614.856
5PC 3 J450	0.5550	1.3437	8.00	21.387	61.958	620.073	34,524.396
5PC 4 J450	0.5182	1.3449	8.00	20.178	52.301	670.463	35,771.549
5PC 5 J450	0.5334	1.3360	8.000	18.272	51.422	576.839	32,463.358
5PC 6 J450	0.5055	1.3360	8.00	20.690	51.685	727.265	38,335.802
5PL 1 J450	0.5613	1.3589	8.00	14.878	47.152	417.012	25,115.247
5PL 2 J450	0.6172	1.3640	8.00	18.877	51.632	435.961	20,608.045
5PL 3 J450	0.6782	1.3284	8.00	18.737	53.900	367.991	16,649.320
5PL 4 J450	0.5296	1.3513	8.00	16.598	44.689	525.520	28,498.034
5PL 5 J450	0.5664	1.3665	8.00	14.599	43.935	399.621	22,648.593
5PL 6 J450	0.5956	1.3589	8.00	13.948	44.528	347.213	19,851.420

TABLE A-3 (CONTINUED)

TYPE OF TESTED SPECIMENS	DEPTH OF BEAM TESTED d (cm)	WIDTH OF BEAM TESTED b (cm)	SPAN L (cm)	LOAD P (cm)	SLOPE m (kg/cm)	FLEXURAL STRENGTH S (kg/cm^2)	FLEXURAL MODULUS E_B (kg/cm^2)
5PC 1 J600	0.7252	1.4148	10.00	22.317	55.264	449.900	25,604.358
5PC 2 J600	0.6731	1.4376	10.00	23.015	49.439	530.036	28,192.452
5PC 3 J600	0.6604	1.4262	10.00	19.527	48.816	470.904	29,709.857
5PC 4 J600	0.6350	1.3030	10.00	17.993	39.662	513.692	29.720.015
5PC 5 J600	0.6883	1.4097	10.00	16.924	40.358	380.112	21,948.742
5PC 6 J600	0.7391	1.3792	10.00	23.386	44.417	465.601	19,941.249
5PL 1 J600	0.7290	1.3487	10.00	16.780	45.249	351.166	21,649.658
5PL 2 J600	0.7087	1.3462	10.00	16.738	46.434	371.330	24,220.643
5PL 3 J600	0.6325	1.3691	10.00	18.133	44.829	496.598	32,350.597
5PL 4 J600	0.5944	1.3716	10.00	17.435	39.849	539.670	34,585.460
5PL 5 J600	0.6198	1.3513	10.00	17.621	41.904	509.175	32,560.345
5PL 6 J600	0.7188	1.3437	10.00	17.575	45.762	379.724	22,925.482

TABLE A-4 DATA AND RESULTS OF COEFFICIENT OF THERMAL CONDUCTIVITY

TYPE OF TESTED SPECIMENS	QUANITY	WIDTH (mm)	LENGTH (mm)	THICKNESS (mm)	COEFFICIENT OF CONDUCTIVITY (kcal/m°C hr)
5 P-P	4	115	140	4	0.1
5P G 450	4	115	140	4	0.1
5P G 600	4	115	140	5	0.1
5P J 450	4	115	140	5	0.12
5P J 600	4	115	140	6	0.13

TABLE A-5 DATA AND RESULTS OF SPECIFIC GRAVITY

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
3PC 1 P 450	1,550	720	440	1.220
3PC 2 P 450	1,580	730	440	1.225
3PC 3 P 450	1,600	725	440	1.217
3PC 4 P 450	1,580	725	440	1.220
3PC 5 P 450	1,500	720	440	1.230
3PC 6 P 450	1,570	725	440	1.222
3PL 1 P 450	1,600	735	440	1.226
3PL 2 P 450	1,630	720	440	1.207
3PL 3 P 450	1,550	710	440	1.211
3PL 4 P 450	1,575	715	440	1.212
3PL 5 P 450	1,550	710	440	1.211
3PL 6 P 450	1,605	720	440	1.211
3PC 1 P 600	2,300	845	440	1 214
3PC 2 P 600	2,270	840	440	1 214

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{aw}{a+w-b}$
3PC 3 P 600	2,310	855	440	1.219
3PC 4 P 600	2,370	855	440	1.212
3PC 5 P 600	2,300	855	440	1.220
3PC 6 P 600	2,275	850	440	1.220
3PL 1 P 600	2,255	840	440	1.216
3PL 2 P 600	2,280	840	440	1.213
3PL 3 P 600	2,290	835	440	1.208
3PL 4 P 600	2,320	840	440	1.208
3PL 5 P 600	2,320	850	440	1.215
3PL 6 P 600	2,290	845	440	1.215

TAB.

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
3PC 1 G 450	2,170	1,065	460	1.387
3PC 2 G 450	1,960	1,050	460	1.431
3PC 3 G 450	2,140	1,090	460	1.417
3PC 4 G 450	2,495	1,160	460	1.390
3PC 5 G 450	2,475	1,150	460	1.387
3PC 6 G 450	2,270	1,070	460	1.367
3PL 1 G 450	2,305	1,080	460	1.368
3PL 2 G 450	2,580	1,150	460	1.365
3PL 3 G 450	2,440	1,155	460	1.398
3PL 4 G 450	2,320	1,030	460	1.326
3PL 5 G 450	2,335	1,065	460	1.350
3PL 6 G 450	2,320	1,025	460	1.322

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w+b}$
3PC 1 G 600	2,955	1,310	460	1.404
3PC 2 G 600	3,290	1,430	460	1.418
3PC 3 G 600	3,220	1,420	460	1.425
3PC 4 G 600	3,065	1,430	460	1.463
3PC 5 G 600	3,365	1,460	460	1.423
3PC 6 G 600	3,480	1,450	460	1.398
3PL 1 G 600	2,655	1,310	460	1.47
3PL 2 G 600	2,845	1,355	460	1.459
3PL 3 G 600	2,840	1,370	460	1.472
3PL 4 G 600	2,950	1,385	460	1.457
3PL 5 G 600	3,025	1,355	460	1.420
3PL 6 G 600	3,580	1,485	460	1.401

TABLE A - 5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
3PC 1 J 450	2,515	740	490	1.110
3PC 2 J 450	2,600	740	490	1.106
3PC 3 J 450	2,785	745	490	1.101
3PC 4 J 450	2,710	730	490	1.097
3PC 5 J 450	3,005	740	490	1.091
3PC 6 J 450	2,750	745	490	1.102
3PL 1 J 450	2,875	810	490	1.125
3PL 2 J 450	2,585	740	490	1.107
3PL 3 J 450	2,535	730	490	1.105
3PL 4 J 450	2,625	800	490	1.134
3PL 5 J 450	2,950	865	490	1.146
3PL 6 J 450	3,000	795	490	1.113

TABLE A - 5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
3PC 1 J 600	3,175	780	490	1.101
3PC 2 J 600	3,250	810	490	1.109
3PC 3 J 600	3,245	755	490	1.089
3PC 4 J 600	3,275	745	490	1.084
3PC 5 J 600	3,240	740	490	1.084
3PC 6 J 600	3,485	785	490	1.092
3PL 1 J 600	3,010	710	490	1.079
3PL 2 J 600	2,960	775	490	1.107
3PL 3 J 600	3,095	750	490	1.092
3PL 4 J 600	2,970	745	490	1.094
3PL 5 J 600	3.085	780	490	1.010
3PL 6 J 600	3,080	790	490	1.108

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
4PC 1 P 450	2,275	835	465	1.194
4PC 2 P 450	2,250	845	465	1.203
4PC 3 P 450	2,390	850	465	1.192
4PC 4 P 450	2,495	845	465	1.180
4PC 5 P 450	2,260	820	465	1.186
4PC 6 P 450	2,285	830	465	1.19[illegible]
4PL 1 P 450	2,075	830	465	1.213
4PL 2 P 450	2,325	865	465	1,208
4PL 3 P 450	2,475	885	465	1.204
4PL 4 P 450	2,270	840	465	1,198
4PL 5 P 450	2,355	875	465	1.211
4PL 6 P 450	2,310	870	465	1.212

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a=w-b}$
4PC 1 P 600	3,295	965	465	1.179
4PC 2 P 600	3,290	955	465	1.175
4PC 3 P 600	3,265	960	465	1.179
4PC 4 P 600	3,215	905	465	1.159
4PC 5 P 600	3,450	965	465	1.169
4PC 6 P 600	3,405	960	465	1.170
4PL 1 P 600	3,255	950	465	1.175
4PL 2 P 600	2,995	915	465	1.177
4PL 3 P 600	3,025	930	465	1.182
4PL 4 P 600	2,995	920	465	1.179
4PL 5 P 600	3,270	940	465	1.170
4PL 6 P 600	3,010	925	465	1.180

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a=w-b}$
4PC 1 G 450	3,545	1.485	475	1.398
4PC 2 G 450	3,040	1.415	475	1.448
4PC 3 G 450	3,675	1,555	475	1.416
4PC 4 G 450	3,350	1,420	475	1.393
4PC 5 G 450	3,565	1,500	475	1.404
4PC 6 G 450	3,470	1,425	475	1,377
4PL 1 G 450	3,060	1,475	475	1.485
4PL 2 G 450	3,400	1,490	475	1.426
4PL 3 G 450	3,035	1,410	475	1.445
4PL 4 G 450	3,090	1,410	475	1,434
4PL 5 G 450	3,560	1,510	475	1,410
4PL 6 G 450	3,465	1,520	475	1.432

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a-w-b}$
4PC 1 G 600	4,510	1,735	475	1.388
4PC 2 G 600	4,250	1,710	475	1.410
4PC 3 G 600	4,910	1,755	475	1.353
4PC 4 G 600	4,460	1.750	475	1.400
4PC 5 G 600	4,280	1,680	475	1.392
4PC 6 G 600	4.585	1,780	475	1.398
4PL 1 G 600	4,270	1,775	475	1,438
4PL 2 G 600	4,25[illegible]	1,770	475	1.438
4PL 3 G 600	4.080	1,735	475	1.447
4PL 4 G 600	4,070	1,550	475	1.395
4PL 5 G 600	4.350	1,680	475	1.383
4PL 6 G 600	4.295	1,670	475	1.385

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY a / a=w-b
4PC 1 J 450	3,710	945	475	1.145
4PC 2 J 450	3,590	910	475	1.138
4PC 3 J 450	4,180	920	475	1.119
4PC 4 J 450	4,060	960	475	1.136
4PC 5 J 460	3,980	925	475	1.127
4PC 6 J 450	3,935	920	475	1.128
4PL 1 J 450	3,755	930	475	1.138
4PL 2 J 450	3,715	920	475	1.136
4PL 3 J 450	3,775	925	475	1.135
4PL 4 J 450	3,780	915	475	1.132
4PL 5 J 450	3,790	910	475	1.130
4PL 6 J 450	3,705	920	475	1.137

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
4PC 1 J 600	4.085	885	475	1.112
4PC 2 J 600	4.480	925	475	1.112
4PC 3 J 600	4,490	935	475	1.114
4PC 4 J 600	4,475	1,005	475	1.134
4PC 5 J 600	4,250	900	475	1.111
4PC 6 J 600	4,475	895	475	1,104
4PL 1 J 600	4.075	875	475	1.109
4PL 2 J 600	4,065	885	475	1.112
4PL 3 J 600	4,015	925	475	1.126
4PL 4 J 600	3,925	925	475	1.129
4PL 5 J 600	3,995	945	475	1.133
4PL 6 J 600	3,990	940	475	1.132

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
5PC 1 P 450	3,075	960	480	1.185
5PC 2 P 450	2,965	915	480	1.172
5PC 3 P 450	3,295	975	480	1.177
5PC 4 P 450	2,980	925	480	1.176
5PC 5 P 450	3,205	985	480	1.187
5PC 6 P 450	3,150	965	480	1.182
5PL 1 P 450	3,175	965	480	1.180
5PL 2 P 450	2,870	905	480	1.174
5PL 3 P 450	3,000	910	480	1.167
5PL 4 P 450	3,090	940	480	1.175
5PL 5 P 450	3,185	950	480	1.173
5PL 6 P 450	3,165	945	480	1.172

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
5PC 1 P 600	3,705	1,045	480	1.130
5PC 2 P 600	3,955	1.060	480	1.172
5PC 3 P 600	3,745	1,040	480	1.176
5PC 4 P 600	3,800	1,060	480	1.130
5PC 5 P 600	3,790	1,035	480	1.172
5PC 6 P 600	3,965	1.070	480	1.175
5PL 1 P 600	3,785	1.040	480	1.174
5PL 2 P 600	3,755	1.050	480	1.179
5PL 3 P 600	3,950	1.065	480	1.174
5PL 4 P 600	3,780	995	480	1,158
5PL 5 P 600	3,710	1.015	480	1.169
5PL 6 P 600	3,800	1.010	480	1.162

TABLE A-5 (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY a / a=w-b
5PC 1 G 450	3,955	1,755	480	1.476
5PC 2 G 450	3,900	1,715	480	1,448
5PC 3 G 450	4,100	1,695	480	1.421
5PC 4 G 450	4,085	1,595	480	1.375
5PC 5 G 450	3,990	1,590	480	1.385
5PC 6 G 450	3,970	1,575	480	1.381
5PL 1 G 450	4.065	1,610	480	1.385
5PL 2 G 450	4,300	1.610	480	1.356
5PL 3 G 450	4,510	1.685	480	1.365
5PL 4 G 450	4.060	1.650	480	1.405
5PL 5 G 450	4,005	1.640	480	1.408
5PL 6 G 450	4,090	1,595	480	1.375

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a-w-b}$
5PC 1 G 600	5,960	2,205	480	1.407
5PC 2 G 600	5,890	2,205	430	1.414
5PC 3 G 600	5,810	2,075	480	1.378
5PC 4 G 600	5,420	2.075	480	1.417
5PC 5 G 600	5,770	2,075	480	1.382
5PC 6 G 600	6,375	2,130	480	1.349
5PL 1 G 600	5,900	2,100	480	1.379
5PL 2 G 600	5,505	2,020	480	1.388
5PL 3 G 600	5,725	2,090	480	1.391
5PL 4 G 600	5,395	2,090	480	1.426
5PL 5 G 600	5,260	2,065	480	1.431
5PL 6 G 600	6,090	2,065	480	1.376

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
5PC 1 J 450	4,050	895	465	1.119
5PC 2 J 450	4,275	980	465	1.137
5PC 3 J 450	4,290	925	465	1.120
5PC 4 J 450	3,805	895	465	1.127
5PC 5 J 450	4,010	890	465	1.119
5PC 6 J 450	4,170	980	465	1,141
5PL 1 J 450	4,400	970	465	1.130
5PL 2 J 450	4,795	975	465	1.119
5PL 3 J 450	5,055	1,055	465	1.132
5PL 4 J 450	4,275	930	465	1.122
5PL 5 J 460	4,485	930	465	1.116
5PL 6 J 450	4,445	875	465	1.102

TABLE (CONTINUED)

TYPE OF TESTED SPECIMENS	a (mg)	b (mg)	w (mg)	SPECIFIC GRAVITY $\frac{a}{a+w-b}$
5PC 1 J 600	5,555	985	465	1.103
5PC 2 J 600	5,495	1,015	465	1.111
5PC 3 J 600	5,595	1,035	465	1.113
5PC 4 J 600	5,065	915	465	1.098
5PC 5 J 600	5,490	940	465	1.095
5PC 6 J 600	5,985	1,085	465	1.116
5PL 1 J 600	5,495	920	465	1.090
5PL 2 J 600	5,570	995	465	1.105
5PL 3 J 600	5,010	1,005	465	1.121
5PL 4 J 600	5,005	960	465	1.110
5PL 5 J 600	5,200	1,000	465	1.115
5PL 6 J 600	5,585	945	465	1.094

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (PURE PLASTIC)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
30	35.294	0.0132	-0.0006	-0.0001	0.0132	-0.0049
40	47.059	0.0158	-0.0008	-0.0002	0.0158	-0.0059
45	52.941	0.0175	-0.0011	-0.0003	0.0175	-0.0067
60	70.588	0.0178	-0.0014	-0.0003	0.0178	-0.0071
75	88.235	0.0187	-0.0019	-0.0005	0.0187	-0.0078
80	94.118	0.0188	-0.0025	-0.0008	0.0188	-0.0083
100	117.647	0.0180	-0.0029	-0.0012	0.0181	-0.0088
110	129.412	0.0172	-0.0033	-0.0017	0.0173	-0.0092
120	141.176	0.0171	-0.0042	-0.0021	0.0172	-0.0099
130	152.941	0.0174	-0.0049	-0.0025	0.0175	-0.0108
150	176.471	0.0175	-0.0059	-0.0029	0.0176	-0.0118
160	188.235	0.0173	-0.0079	-0.0034	0.0176	-0.0129
175	205.880	0.0155	-0.0055	-0.0024	0.0156	-0.0105

$$\therefore \nu = \frac{d\epsilon_t/dP}{d\epsilon_1/dP} = 0.42$$

$$E = \frac{d\sigma}{d\epsilon_1} = 4,103.453 \text{ ksc}$$

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5 PC 1 G450)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
80	117.647	0.0352	0	-0.0006	0.0352	- 0.0121
320	470.588	0.0398	0.0003	-0.0007	0.0397	- 0.0135
360	529.412	0.0425	0.0004	-0.0008	0.0425	- 0.0144
390	573.529	0.0456	0.0005	-0.0010	0.0456	- 0.0155
420	617.647	0.0472	0.0003	-0.0011	0.0472	- 0.0163
460	676.471	0.0485	0.0001	-0.0014	0.0485	- 0.0170
490	720.588	0.0482	-0.0002	-0.0017	0.0482	- 0.0173
530	779.412	0.0468	-0.0004	-0.0022	0.0468	- 0.0173
560	823.529	0.0456	-0.0009	-0.0026	0.0459	- 0.0176
600	882.353	0.0448	-0.0013	-0.0031	0.0448	- 0.0179
640	941.176	0.0439	-0.0017	-0.0037	0.0440	- 0.0183
670	985.294	0.0432	-0.0020	-0.0041	0.0432	- 0.0185
710	1,044.118	0.0424	-0.0024	-0.0046	0.0424	- 0.0188
730	1,073.529	0.0411	-0.0029	-0.0050	0.0412	- 0.0190
765	1,125.000	0.0397	-0.0034	-0.0055	0.0397	- 0.0192

$\therefore \nu$ = 0.362

E = 19,691.885 ksc

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5PC 2 G 450)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
90	132.353	0.0101	0.0001	0.0009	0.0101	-0.0039
180	264.706	0.0175	0.0003	0	0.0175	-0.0056
240	352.941	0.0254	0.0006	-0.0004	0.0254	-0.0083
310	455.882	0.0367	0.0007	-0.0010	0.0367	-0.0124
370	544.118	0.0433	0.0006	-0.0017	0.0433	-0.0152
430	632.353	0.0489	0.0004	-0.0027	0.0489	-0.0178
510	750.000	0.0527	0.0007	-0.0035	0.0528	-0.0195
570	838.235	0.0499	0.0005	-0.0053	0.0501	-0.0201
640	941.176	0.0470	0.0002	-0.0058	0.0471	-0.0196
710	1,044.118	0.0420	0.0004	-0.0059	0.0421	-0.0184

$\therefore \nu$ = 0.373

E = 10,834.961 ksc

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5PL 1 G 450)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
60	88.235	0.0057	-0.0003	0.0002	0.0057	- 0.0020
140	205.882	0.0121	-0.0008	0.0003	0.0121	- 0.0044
200	294.118	0.0191	-0.0012	0.0003	0.0191	- 0.0070
300	441.176	0.0301	-0.0017	0.0004	0.0302	- 0.0110
400	588.235	0.0396	-0.0025	0.0003	0.0397	- 0.0147
500	735.294	0.0416	-0.0038	0.0005	0.0416	- 0.0168
610	897.059	0.0423	-0.0058	0.0017	0.0423	- 0.0191
710	1,044.118	0.0392	0.0075	0.0029	0.0393	- 0.0202
780	1,147.059	0.0371	0.0081	0.0035	0.0372	- 0.0202

$\therefore \nu$ = 0.374

E = 15,395.768 ksc

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5PC 1 G 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
90	105.882	0.0105	-0.0002	0.0009	0.0105	- 0.0031
190	223.529	0.0181	-0.0006	0.0013	0.0182	- 0.0056
270	317.647	0.0241	-0.0012	0.0016	0.0242	- 0.0078
370	435.294	0.0295	-0.0024	0.0014	0.0295	- 0.0106
460	541.176	0.0309	-0.0047	0.0001	0.0311	- 0.0135
560	658.824	0.0330	-0.0065	-0.0010	0.0332	- 0.0162
660	776.471	0.0348	-0.0094	-0.0024	0.0351	- 0.0198
730	858.824	0.0369	-0.0116	-0.0029	0.0373	- 0.0224
840	988.235	0.0312	-0.0151	-0.0045	0.0319	- 0.0241
940	1,105.882	0.0252	-0.0175	-0.0069	0.0259	- 0.0254
1,040	1,223.529	0.0202	-0.0180	-0.0081	0.0210	- 0.0248

$\therefore \nu =$ 0.347

E = 15,490.428

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5PC 2 G 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
140	164.706	0.0001	0	0	0.0069	- 0.0022
280	329.412	0.0069	-0.0001	0.0002	0.0129	- 0.0049
370	435.294	0.0129	-0.0011	0.0002	0.0107	- 0.0068
460	541.176	0.0104	-0.0041	- 0.0005	0.0068	- 0.0076
550	647.059	0.0062	-0.0062	-0.0011	0.0093	- 0.0094
620	729.412	0.0087	-0.0074	-0.0015	0.0094	- 0.0103
700	823.529	0.0037	-0.0082	-0.0018	0.0067	- 0.0102
750	882.353	0.0057	-0.0089	-0.0019	0.0078	- 0.0101
790	929.412	0.0062	-0.0086	-0.0019	0.0074	- 0.0100
850	1,000.000	0.0045	-0.0083	-0.0020	0.0055	- 0.0094
900	2,058.824	0.0036	-0.0085	-0.0019	0.0047	- 0.0093
960	1,129.412	0.0023	-0.0084	-0.0017	0.0036	- 0.0088

$\therefore \nu = 0.353$

$E = 23,341.065$ ksc

TABLE. A66 DATA AND RESULTS OF POISSON'S RATIO (5PL 1 G 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
80	94.118	0.0030	0	0	0.0030	- 0.0010
180	211.765	0.0061	- 0.0007	- 0.0005	0.0061	- 0.0028
240	282.353	0.0038	-0.0021	- 0.0022	0.0038	- 0.0041
320	376.471	0.0041	- 0.0033	- 0.0040	0.0415	- 0.0062
380	447.059	0.0047	- 0.0045	- 0.0055	0.0140	- 0.0082
450	529.412	0.0053	-0.0055	- 0.0067	0.0054	- 0.0099
580	682.353	0.0059	-0.0070	- 0.0083	0.0059	- 0.0122
650	764.706	0.0058	-0.0070	- 0.0085	0.0059	- 0.0123
770	905.882	0.0057	-0.0069	- 0.0093	0.0058	- 0.0127
880	1,035.294	0.0059	-0.0062	- 0.0101	0.0061	- 0.0131
980	1,152.941	0.0054	-0.0056	- 0.0094	0.0057	- 0.0121
1,010	1,188.235	0.0042	-0.0065	- 0.0087	0.0043	- 0.0117

$\therefore \nu = 0.456$

$E = 38,813.302$ ksc

TABLE. A-6 DATA AND RESULTS OF POISSON'S RATIO (5PL 2 G 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
150	176.471	0.0089	-0.0001	-0.0001	0.0089	-0.0031
190	223.529	0.0118	-0.0002	-0.0001	0.0117	-0.0041
210	247.059	0.0136	-0.0003	-0.0001	0.0136	-0.0048
260	3.5.882	0.0177	-0.0004	-0.0002	0.0176	-0.0063
340	400.000	0.0249	-0.0010	-0.0003	0.0249	-0.0092
430	505.882	0.0325	-0.0017	-0.0005	0.0325	-0.0123
540	635.294	0.0402	-0.0027	-0.0009	0.0402	-0.0158
635	040.059	0.0456	-0.0042	-0.0014	0.0456	-0.0189
730	858.-23	0.0390	-0.0055	-0.0019	0.0391	-0.0130
820	964.706	0.0289	0.0003	0.0024	0.0290	-0.0079
920	1,082.353	0.0297	0.0012	0.0031	0.0297	-0.0071
' 0	1,164.706	0.0295	0.0007	0.0033	0.0295	-0.0072

$\therefore \nu = 0.362$

$E = 14,988.427$ ksc

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5PC 1 J 450)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
120	141.176	0.0326	0.0007	0.0018	0.00326	- 0.0093
150	176.471	0.0400	0.0008	0.0021	0.0340	- 0.0114
190	223.529	0.0396	0.0002	0.0020	0.0396	- 0.0118
220	258.824	0.0305	-0.0028	0.0009	0.0306	- 0.0116
240	282.353	0.0243	-0.0052	-0.0005	0.0245	- 0.0121
270	317.647	0.0217	-0.0057	- 0.0016	0.0218	- 0.0123

$\therefore \nu = 0.291$

$E = 4,781.289$ ksc

TABLE. A-6 DATA AND RESULTS OF POISSON'SRATIO (5PC 2 J 450)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_l	ϵ_t
30	35.294	0.0028	0.0001	- 0.0001	0.0028	- 0.0009
60	70.588	0.0053	0.0003	- 0.0002	0.0053	- 0.0017
90	105.882	0.0100	0.0004	- 0.0003	0.0100	- 0.0032
130	152.941	0.0164	0.0004	- 0.0003	0.0164	- 0.0054
165	194.118	0.0203	0.0020	0.0003	0.0203	- 0.0053
190	223.529	0.0153	0.0034	0.0019	0.0153	- 0.0017
235	276.471	0.0176	0.0039	0.0024	0.0176	- 0.0017
280	329.412	0.0219	0.0044	0.0028	0.0219	- 0.0026
320	376.471	0.0114	0.0015	0.0017	0.0114	- 0.0017
330	388.235	0.0079	0.0009	0.0015	0.0079	- 0.0010

$\therefore \nu = 0.334$

$E = 9,843.948$ ksc

TABLE. A-6 DATA AND RESULTS OF POISOON'S RATIO (5PL 1 J 450)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
60	70.588	0.0135	0.0024	0.0024	0.0135	- 0.0013
90	105.882	0.0234	0.0051	0.0044	0.0234	- 0.0015
105	123.529	0.0280	0.0073	0.0060	0.0280	- 0.0004
120	141.176	0.0338	0.0055	0.0080	0.0339	- 0.0023
135	158.824	0.0427	0.0020	0.0097	0.0431	- 0.0068

$\therefore \nu = 0.228$

$E = 3{,}668.942$ ksc

TABLE. A-6 DAYA AND RESULTS OF POISSON'RATIO (5PL 2 J 450)

LOAD P (kg)	TENSILE STRESS (kg/cm²)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
60	70.588	0.0152	0.0019	0.0003	0.0152	- 0.0036
130	152.941	0.0307	0.0036	0.0012	0.0308	- 0.0071
160	188.235	0.0385	0.0042	0.0016	0.0380	- 0.0091

$\therefore \nu = 0.232$

$E = 5,031.692$ ksc

TABLE A-6 DATA AND RESULTS OF POISSON'S RATIO (5PC 1 J 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
75	73.529	0.0059	0.0001	0.0007	0.0059	- 0.0014
95	93.137	0.0090	0.0002	0.0011	0.0090	- 0.0022
110	107.843	0.0125	0.0002	0.0015	0.0125	- 0.0031
135	132.353	0.0150	- 0.0001	0.0017	0.0151	- 0.0040
160	156.863	0.0120	- 0.0015	0.0012	0.0121	- 0.0043
200	196.078	0.0117	- 0.0046	0.0005	0.0122	- 0.0071
215	210.784	0.0109	- 0.0056	- 0.0001	0.0114	- 0.0080
230	225.490	0.0099	- 0.0063	- 0.0015	0.0103	- 0.0089
250	245.098	0.0101	- 0.0065	- 0.0026	0.0104	- 0.0097

$\therefore \nu \approx 0.284$

$E = 6,308.068$ ksc

TABLE. A-6 DATA AND RESULTS OF POISSON'RATIO (5PC 2 J 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
25	24.510	0.0072	0.0002	0.0004	0.0072	- 0.0021
40	39.216	0.0099	0.0002	0.0009	0.0099	- 0.0026
60	58.824	0.0160	0.0002	0.0011	0.0160	- 0.0044
70	68.627	0.0192	0.0003	0.0014	0.0192	- 0.0053
80	78.431	0.0227	0.0003	0.0017	0.0227	- 0.0063
110	107.843	0.0285	0.0004	0.0020	0.0285	- 0.0079
170	166.667	0.0465	0.0012	0.0040	0.0466	- 0.0121
220	215.686	0.0616	0.0020	0.0056	0.0463	-0.0310
260	254.902	0.0692	0.0030	0.0048	0.0672	-0.0199

$\therefore \nu = 0.275$

$E = 2{,}922.231$ ksc

TABLE. A-6 DATA AND RESULTS OF POISSON'S RATIO (5PL 1 J 600)

LOAD P (kg)	TENSILE STRESS (kg/cm.^{2})	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
40	39.216	0.0139	0.0004	0.0008	0.0139	-0.0039
80	78.430	0.0229	0.0007	0.0014	0.0229	-0.0062
115	112.745	0.0307	0.0010	0.0020	0.0307	-0.0082
150	147.059	0.0410	0.0013	0.0028	0.0410	-0.0109
200	196.078	0.0525	0.0016	0.0042	0.0525	-0.0116
240	235.294	0.0594	0.0012	0.0044	0.0595	-0.0161

$\therefore \nu = 0.26$

$E = 4,355.417$ ksc

TABLE. A-6 DATA AND RESULTS OF POISSON'S RATIO (5PL 2 J 600)

LOAD P (kg)	TENSILE STRESS (kg/cm^2)	ϵ_a	ϵ_b	ϵ_c	ϵ_1	ϵ_t
20	19.608	0.0051	0.0003	0.0003	0.0051	-0.0013
35	34.314	0.0102	0.0008	0.0006	0.0102	-0.0025
70	68.627	0.0186	0.0019	0.0011	0.0186	-0.0043
110	107.843	0.0322	0.0036	0.0022	0.0322	-0.0069
180	176.471	0.0501	0.0057	0.0035	0.0501	-0.0105
220	215.686	0.0607	0.0112	0.0041	0.0609	-0.0103
235	230.392	0.0554	0.0092	0.0050	0.0554	-0.0091

$\therefore \ \nu = 0.208$

$E = 3,259.476$ ksc

TABLE A-7 LONGITUDINAL STRESSES UNDER INTERNAL PRESSURE (For cylindrical tank with hemispherical ends made of GRP)

POINT NUMBER OF STRAIN GAGE AROUND TANK	INTERNAL PRESSURE P = 0 ksc		INTERNAL PRESSURE P=0.3515 ksc		INTERNAL PRESSURE P = 0.703 ksc		INTERNAL PRESSURE P = 1.0545 ksc		INTERNAL PRESSURE P = 1.406 ksc	
	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)
1	-0.00001	-0.171	0.00075	12.839	0.00234	40.057	0.00426	72.923	0.00591	101.168
2	0.00008	1.370	0.00134	22.938	0.00343	58.715	0.00584	99.970	0.00801	137.116
3	0.00004	0.685	0.00064	10.956	0.00102	17.460	0.00114	19.515	0.00123	21.055
4	0.00001		0.00012		0.00019		0.00039		0.00055	
5	-0.00002	0.324	0.00003	6.294	0.00009	13.522	0.00019	19.474	0.00029	22.981
6	0.00001		0.00029		0.00066		0.00089		0.00102	
7	0.00001	0.171	0.00178	30.470	0.00410	70.184	0.00633	108.357	0.00807	138.143
8	0.00017	2.910	0.00276	47.246	0.00692	118.457	0.01168	199.939	0.01583	270.980
9	0.00003	0.513	0.00101	17.289	0.00308	52.724	0.00542	92.780	0.00802	137.287
10	0		0.00139		0.00357		0.00618		0.00851	
11	0	0	0.00046	28.914	0.00113	74.230	0.00195	128.235	0.00269	176.530
12	0		0.00023		0.00058		0.00097		0.00133	

TABLE A-7 (CONTINUED)

POINT NUMBER OF STRAIN GAGE AROUND TANK	INTERNAL PRESSURE p = 0 ksc		INTERNAL PRESSURE p = 0.3515 ksc		INTERNAL PRESSURE p = 0.703 ksc		INTERNAL PRESSURE p = 1.0545 ksc		INTERNAL PRESSURE p = 1.406 ksc	
	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)
13	-0.00004		0.00025		0.00080		0.00136		0.00178	
14	0	-0.283	0.00004	8.557	0.00012	24.505	0.00023	43.553	0.00033	60.709
15	0		0.00035		0.00098		0.00174		0.00248	
16	0.00003		0.00010		0.00018		0.00011		-0.00001	
17	0.00002	0.535	0.00015	7.178	0.00027	18.251	0.00029	27.322	0.00009	30.104
18	0		0.00035		0.00093		0.00147		0.00169	
19	0.00001		0.00083		0.00163		0.00223		0.00202	
20	0.00005	0.654	0.00055	17.900	0.00120	45.282	0.00169	49.357	0.00191	44.446
21	0.00003		0.00028		0.00071		0.00096		0.00093	
22	0.00004	0.685	0.00117	20.028	0.00239	40.912	0.00334	57,174	0.00416	71.211
23	0.00001	0.171	0.00085	14.550	0.00239	40.912	0.00412	70.526	0.00572	97.916
24	0.00003	0.513	0.00072	12.325	0.00201	33.973	0.00347	59.400	0.00480	82.167

NOTE : No. 1,2,3,7,8,9,22,23 and 24 are strain gage type KFC-1-C1-11

No. (4,5,6),(10,11,12),(13,14,15),(16,17,18) and (19,20,21) are strain gage type KFC-2-D17-11

TABLE A-8 LONGITUDINAL STRESSES UNDER INTERNAL PRESSURE (For cylindrical tank with hemispherical ends made of JRP)

POINT NUMBER OF STRAIN GAGE AROUND TANK	INTERNAL PRESSURE p = 0 ksc		INTERNAL PRESSURE p = 0.3515 ksc		INTERNAL PRESSURE p = 0.5624 ksc	
	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)	ϵ	σ_1 (ksc)
1	-0.00001	-0.048	0.00360	17.186	0.00481	22.962
2	-0.00002	-0.096	0.00633	30.218	0.00851	40.625
3	0.00001	0.048	0.00522	24.920	0.00673	32.128
4	0.00004		0.00373		0.00468	
5	0.00005	0.260	0.00676	60.03	0.00866	77.54
6	0.00004		0.01124		0.01457	
7	-0.00001	-0.048	0.00400	19.095	0.00476	22.723
8	0	0	0.00646	30.839	0.00851	40.625
9	-0.00001	-0.048	0.00110	5.251	0.00136	6.493
10	0.00002		0.00121		0.00165	
11	0.00001	0.130	0.00109	7.786	0.00150	11,324
12	0.00002		0.00117		0.00160	

TABLE A-8 (CONTINUED)

POINT NUMBER OF STRAIN GAGE AROUND TANK	INTERNAL PRESSURE P = 0 ksc		INTERNAL PRESSURE P = 0.3515 ksc		INTERNAL PRESSURE P = 0.5624 ksc	
		(ksc)		(ksc)		(ksc)
13	0.00003		0.00125		0.00175	
14	0.00002	0.181	0.00044	6.333	0.00066	8.887
15	0.00002		0.00003		0.00007	
16	-0.00007		0.00089		0.00091	
17	0.00002	-0.068	0.00018	4.557	0.00005	4.695
18	0.00002		0.00001		0.00002	
19	0.00002		-0.00046		-0.00056	
20	-0.00005	0.114	0.00007	1.030	0.00027	1.577
21	0.00001		0.00031		0.00046	
22	-0.00003	-0.143	-0.00272	12.985	-0.00324	-15.467
23	0	0	0.00301	14.369	0.00399	19.048
24	-0.00002	-0.025	0.00261	12.460	0.00348	16.613

TABLE A-9 HOOP STRESSES UNDER INTERNAL PRESSURE (For cylindrical tank with hemispherical ends made of GRP)

POINT NUMBER OR STRAIN GAGE AROUND TANK	INTERNAL PRESSURE p = 0 ksc		INTERNAL PRESSURE p = 0.3515 ksc		INTERNAL PRESSURE p= 0.703 ksc		INTERNAL PRESSURE p = 1.0545 ksc		INTERNAL PRESSURE p = 1.406 ksc	
	ϵ	σ_h (ksc)	ϵ	σ_h (ksc)	ϵ	σ_h (ksc)	ϵ	σ_h (ksc)	ϵ	σ_h (ksc)
4	0.00001		0.00012		0.00019		0.00039		0.00055	
5	-0.00002	0.324	0.00003	4.704	0.00009	9.283	0.00019	14.865	0.00029	18.153
6	0.00001		0.00029		0.00066		0.00089		0.00102	
19	0.00001		0.00083		0.00163		0.00223		0.00202	
20	0.00005	0.416	0.00055	11.879	0.00120	17.497	0.00169	36.227	0.00191	34.700
21	0.00003		0.00028		0.00071		0.00096		0.00093	
25	-0.00001	-0.171	0.00154	26.362	0.00857	146.702	0.01788	306.071	0.02641	452.089
26	-	-	-	-	-	-	-	-	-	-
27	0.00001	0.171	0.00568	97.231	0.01409	241.194	0.02155	368.895	0.02661	455.512
28	-0.00003	-0.513	0.00608	104.078	0.01591	272.349	0.02704	462.873	0.03714	635.766
29	-0.00007	-1.198	0.00370	63.337	0.01162	198.912	0.02208	377.967	0.03138	537.166
30	0	0	0.00705	120.683	0.01590	272.178	0.02502	428.295	0.03214	550.175

NOTE: No. 25,26,27,28,29 and 30 are strain gage type KFC-1-C1-11

No. (4,5,6) and (19,20,21) are strain gage type KFC-2-D17-11

TABLE. A-10 HOOP STRESSES UNDER INTERNAL PRESSURE (For cylindrical tank with hemisphorical ends made of JRP)

POINT NUMBER OF GAGE AROUND TANK	INTERNAL PRESSURE P = 0 ksc		INTERNAL PRESSURE P = 0.3515 ksc		INTERNAL PRESSURE P = o.5624 ksc	
		h (hsc)		h		h (ksc)
4	0.00004		0.00373		0.00468	
5	0.00005	0.260	0.00676	37.047	0.00866	47.293
6	0.00004		0.01134		0.01457	
19	0.00002		-0.00046		-0.00056	
20	-0.00005	0.080	0.00007	1.941	0.00027	-2.226
21	0.00001		0.00031		0.00046	
25	-0.00003	-0.143	0.00950	45.351	0.01375	65.640
26	0.00002	0.096	0.01071	51.128	0.01475	70.414
27		0	0.00329	15.706	0.00676	32.271
28	0.00005	0.239	0.01865	89.032	0.02309	110.228
29	0.00003	0.143	0.00449	21.434	0.00565	26.972
30	0.00003	0.143	0.00233	11.123	0.00358	17.090

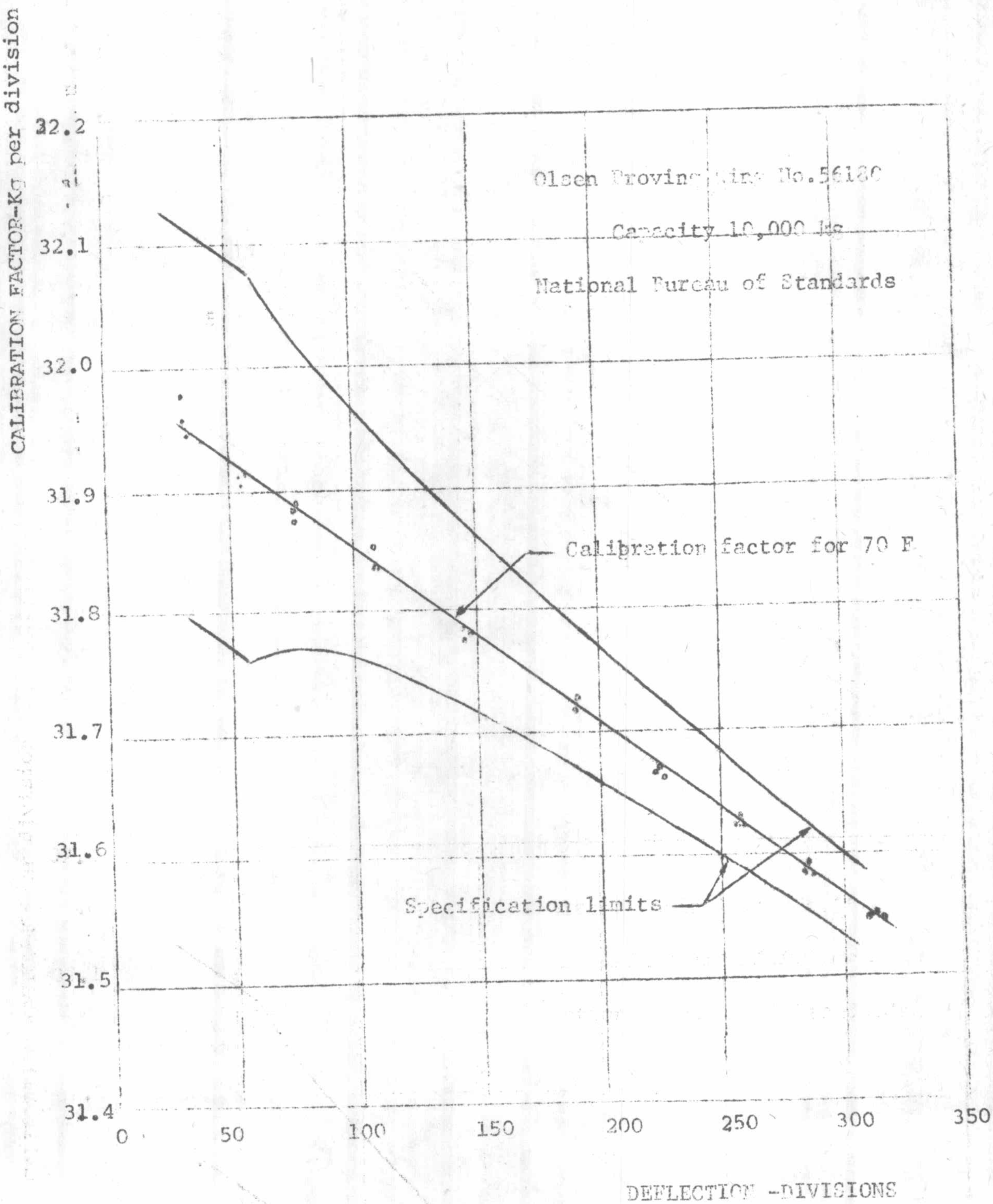

Fig. A-5 CALIBRATION CURVE OF PROVING RING NO. 56180

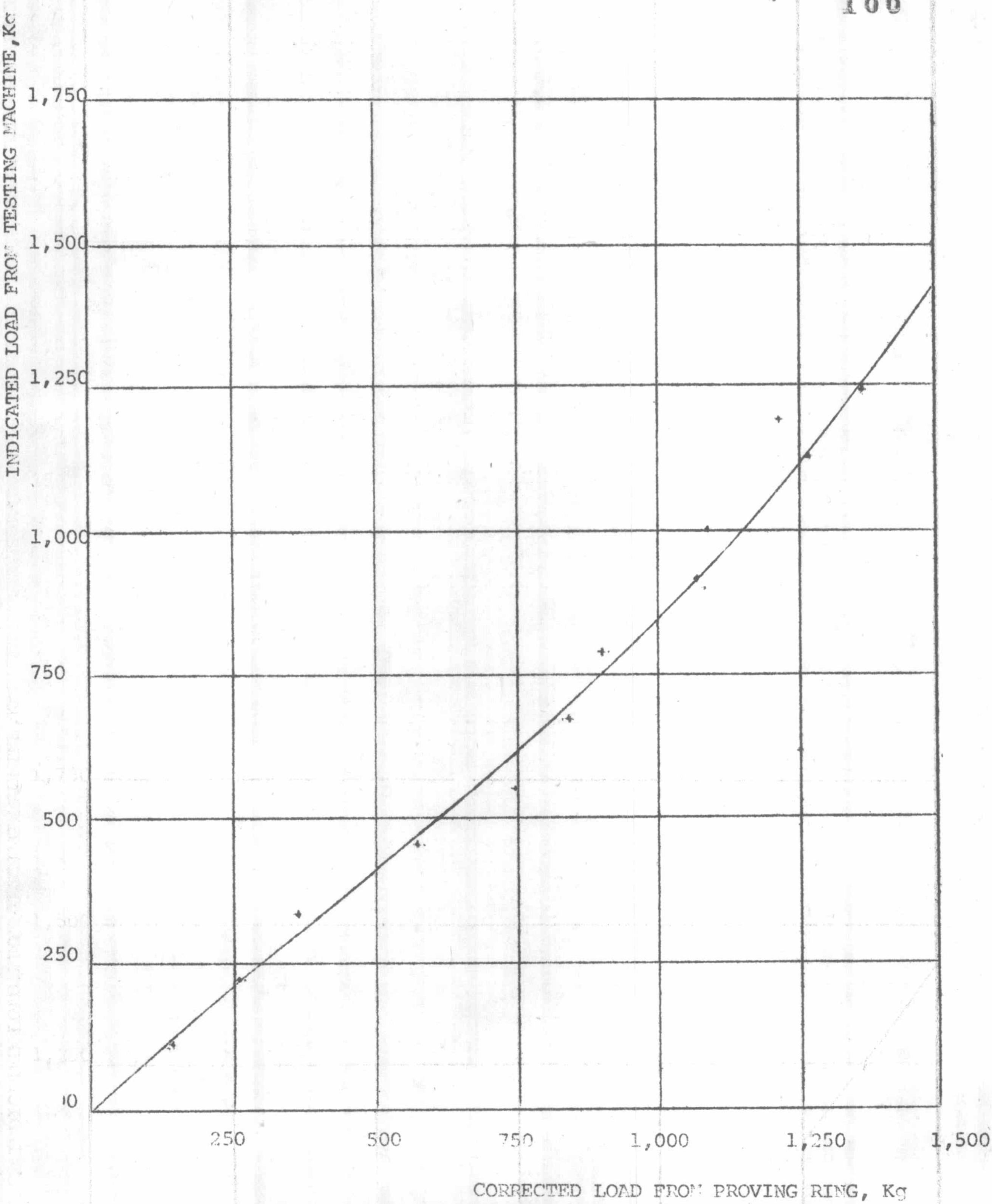

Fig. A-6 CALIBRATION CURVE OF "AVERY" TESTING MACHINE

NO. E 66110 CAPACITY 15,000 lb (6,000 Kg)

LOAD RANGE 0-3,000 lb (0-1,360 Kg)

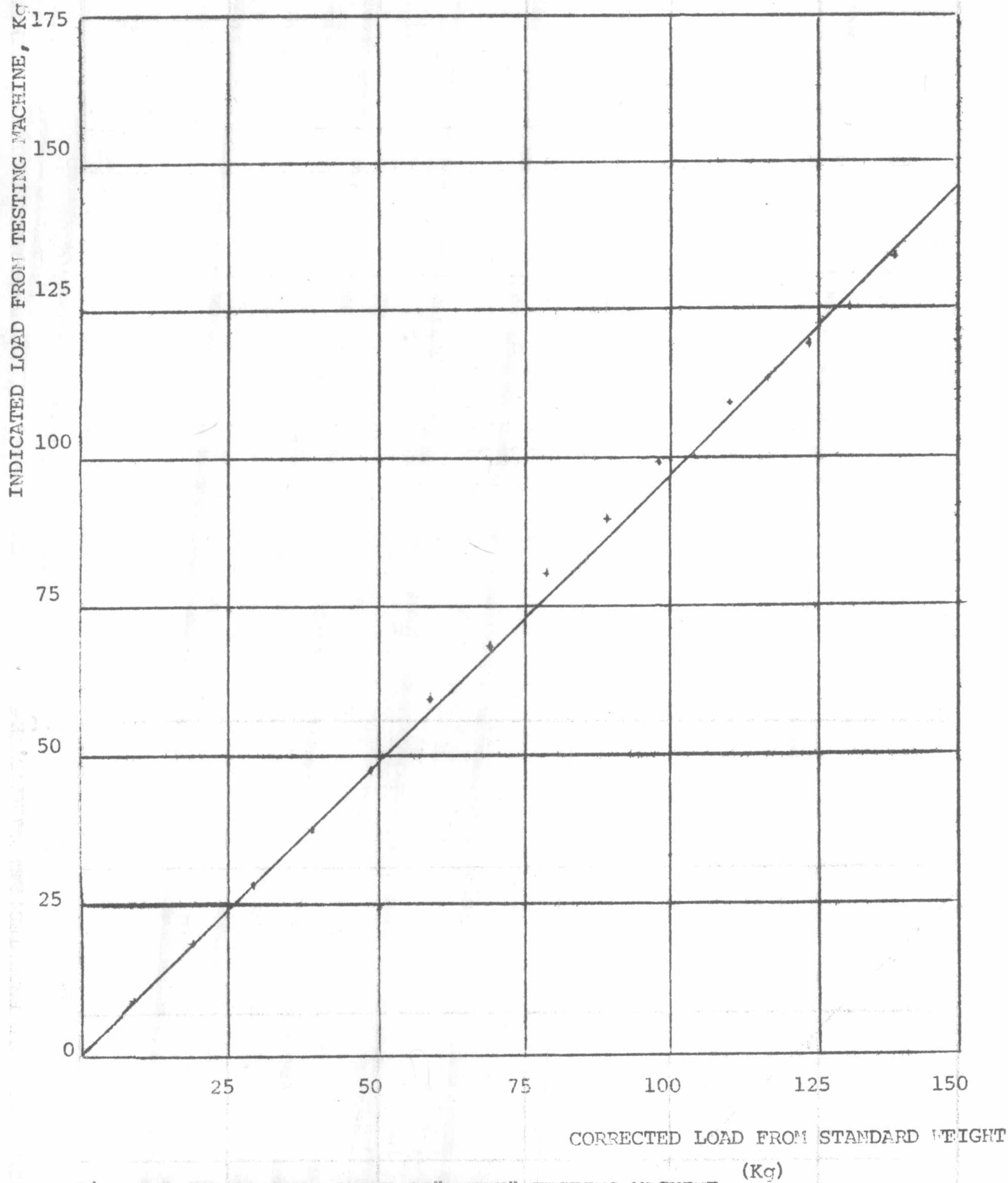

Fig. A-7 CALIBRATION CURVE OF "AVERY" TESTING MACHINE

NO.E 66110 CAPACITY 15,000 lb (6,800 Kg)

LOAD RANGE 0-300 lb (0-136 Kg)

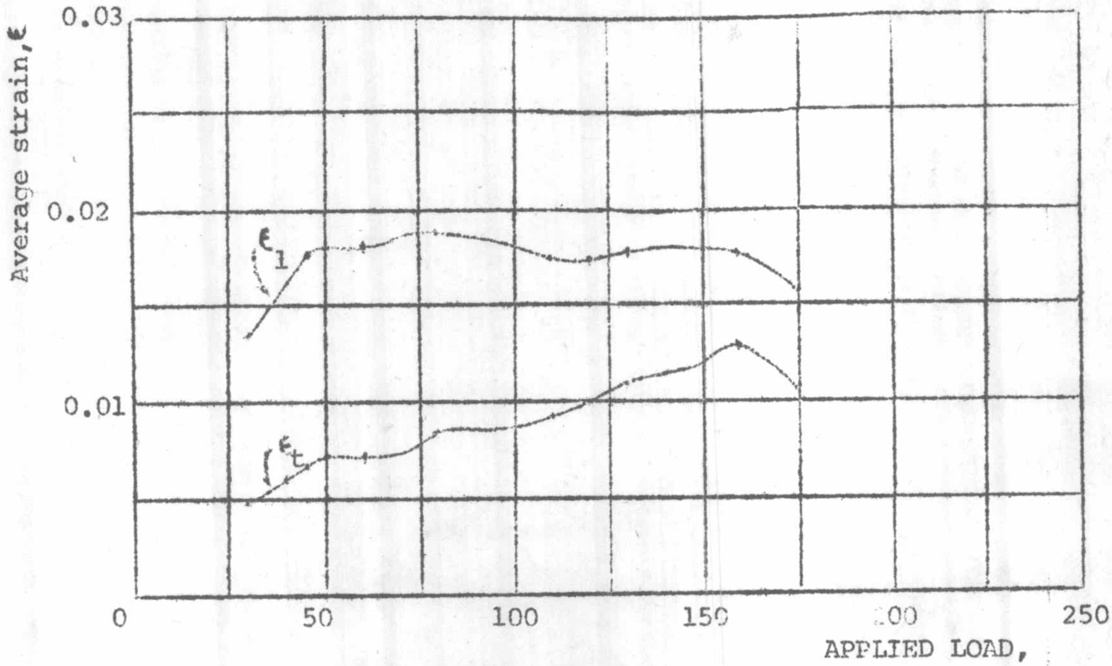

Fig A-8 PLOT OF AVERAGE STRAINS VERSUS LOAD

FOR DETERMINATION OF POISSON'S RATIO (PURE PLASTIC)

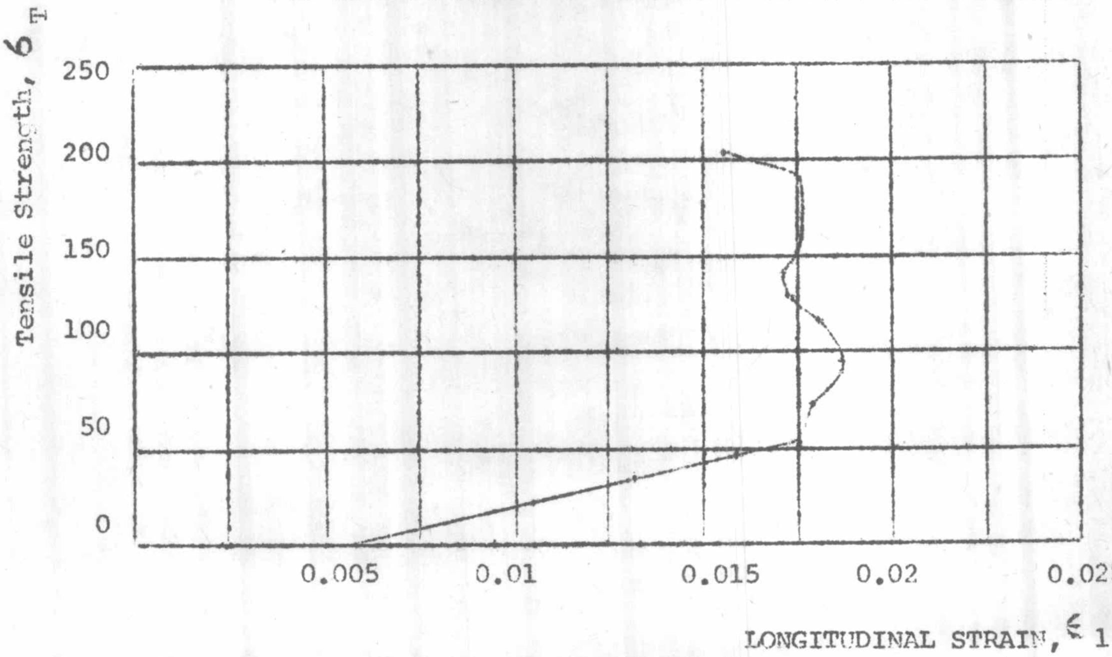

Fig. A-9 STRESS-STRAIN CURVE (PURE PLASTIC)

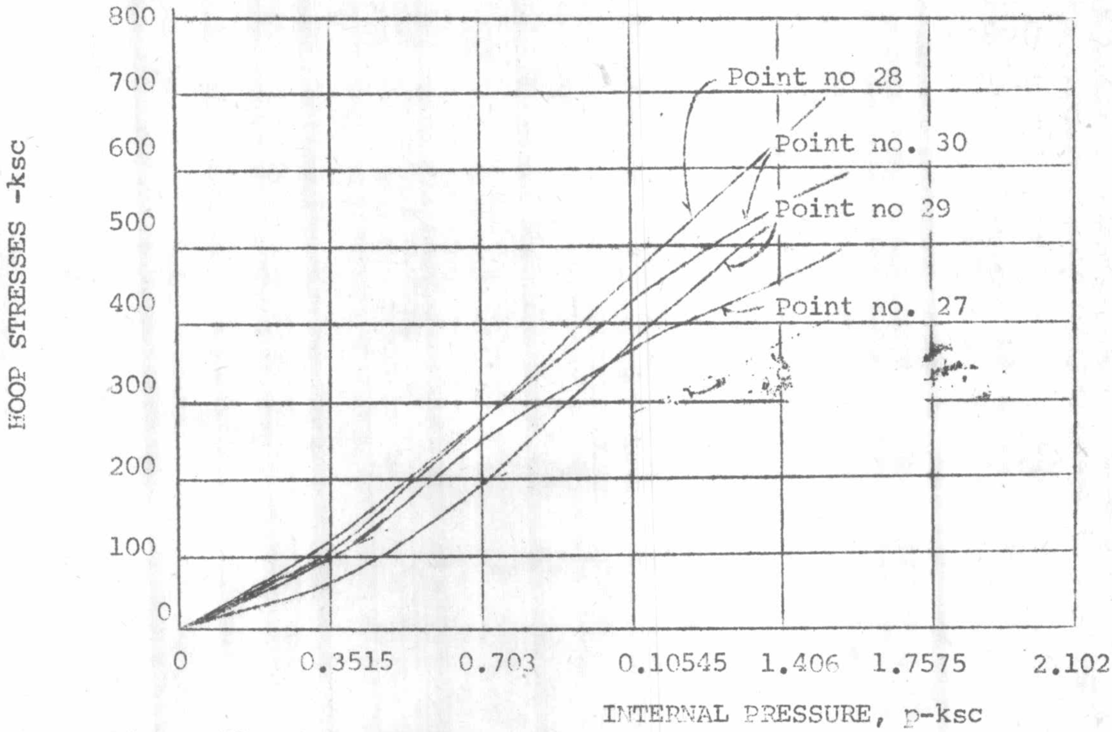

Fig A-10. HOOP STRESSES UNDER INTERNAL PRESSURE

(For cylindrical tank with hemispherical ends made of GRP)

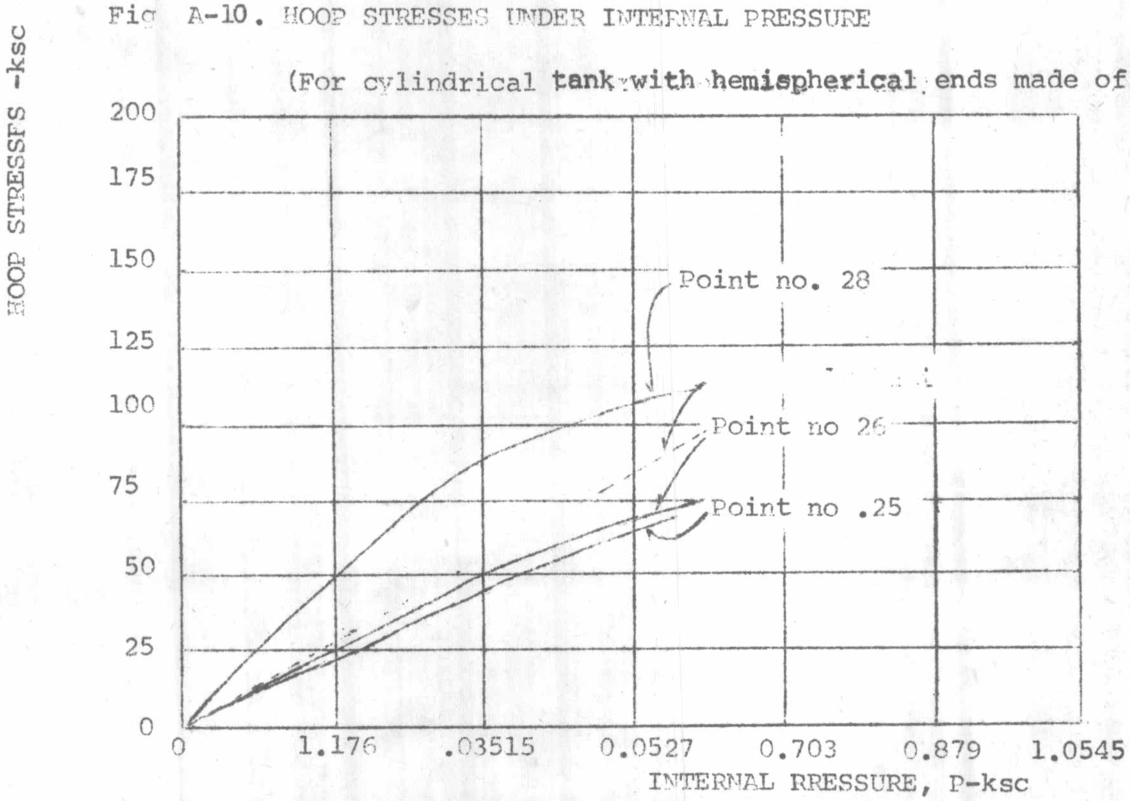

Fig. A-11 HOOP STRESSES UNDER INTERNAL PRESSURE

(For cylindrical tank with hemispherical ends made of JRP)

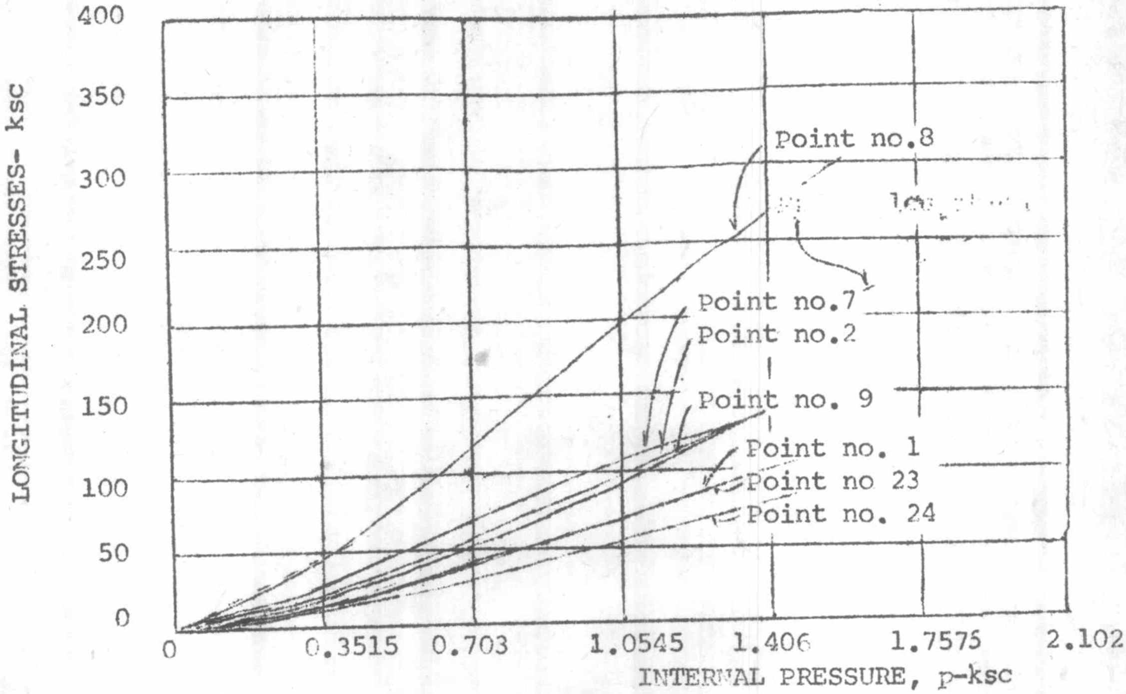

Fig A-12 LONGITUDINAL STRESSES UNDER INTERNAL PRESSURE

(For cylindrical tank with hemispherical ends made of GRP)

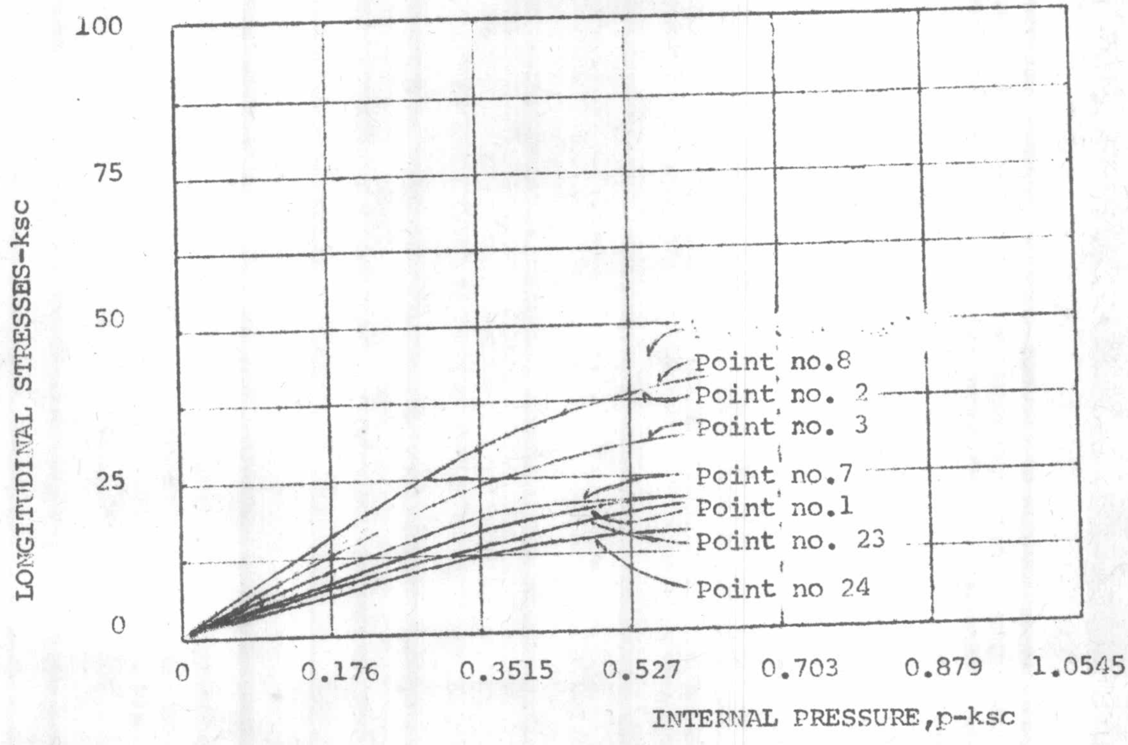

Fig. A-13 LONGITUDINAL STRESS UNDER INTERNAL PRESSURE

(For cylindricaltank with hemispherical ends

made of JRP)

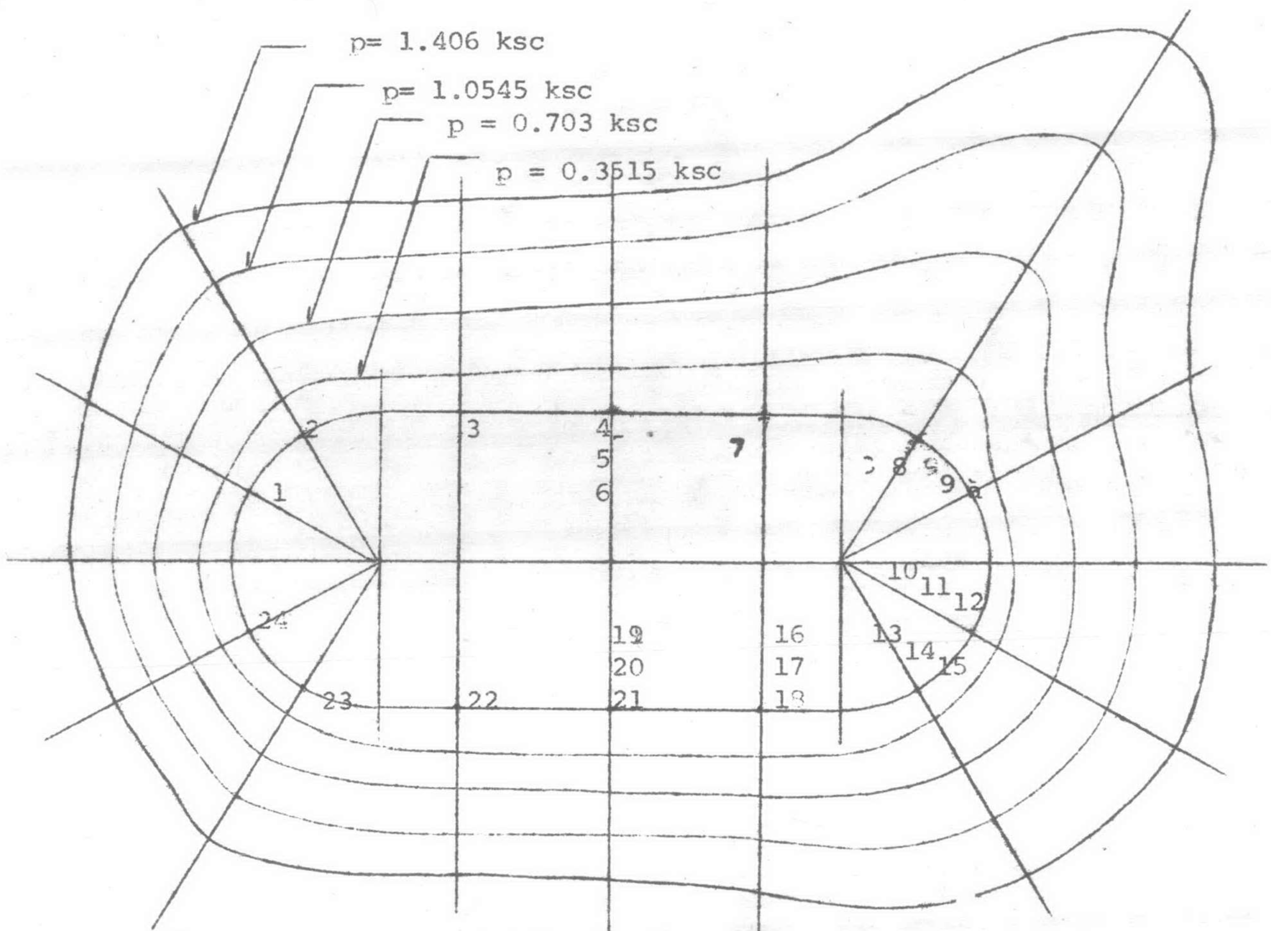

Fig. A-14 LONGITUDINAL STRESSES DISTRIBUTED AROUND A GRP CYLINDRICAL TANK WITH HEMISPHERICAL ENDS

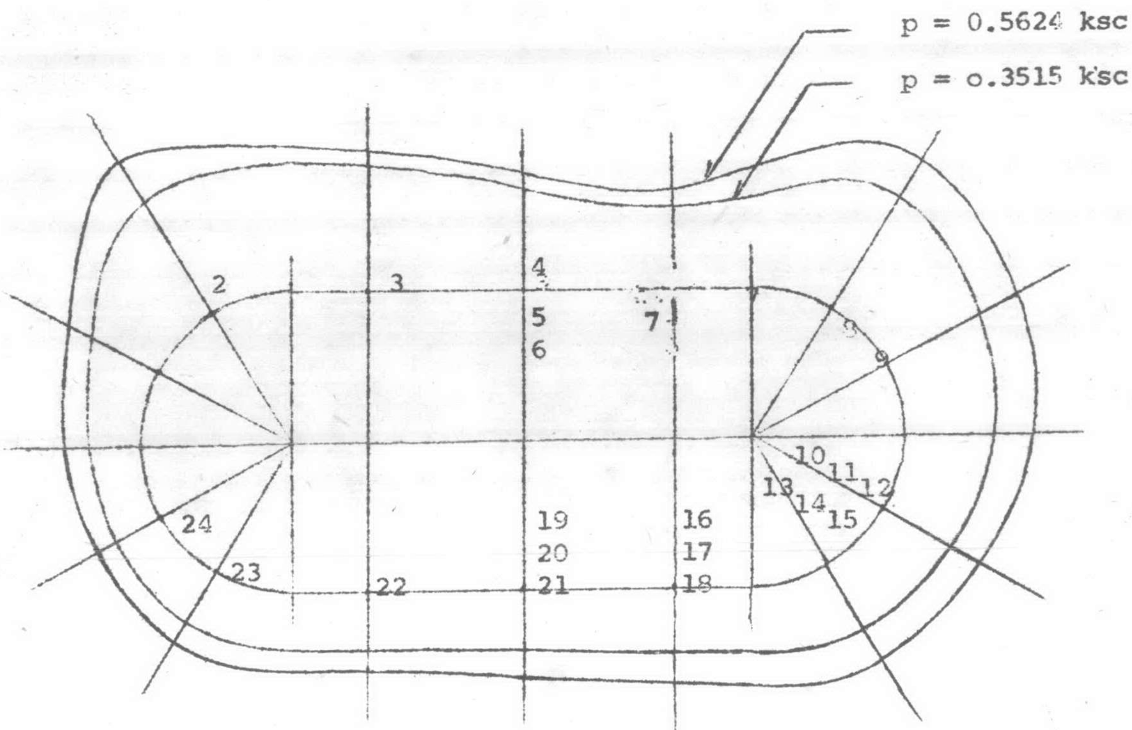

Fig A-15 LONGITUDINAL STRESSES DISTRIBUTED AROUND A JRP CYLINDRICAL [illegible]

TANK WITH HEMISPHERICAL

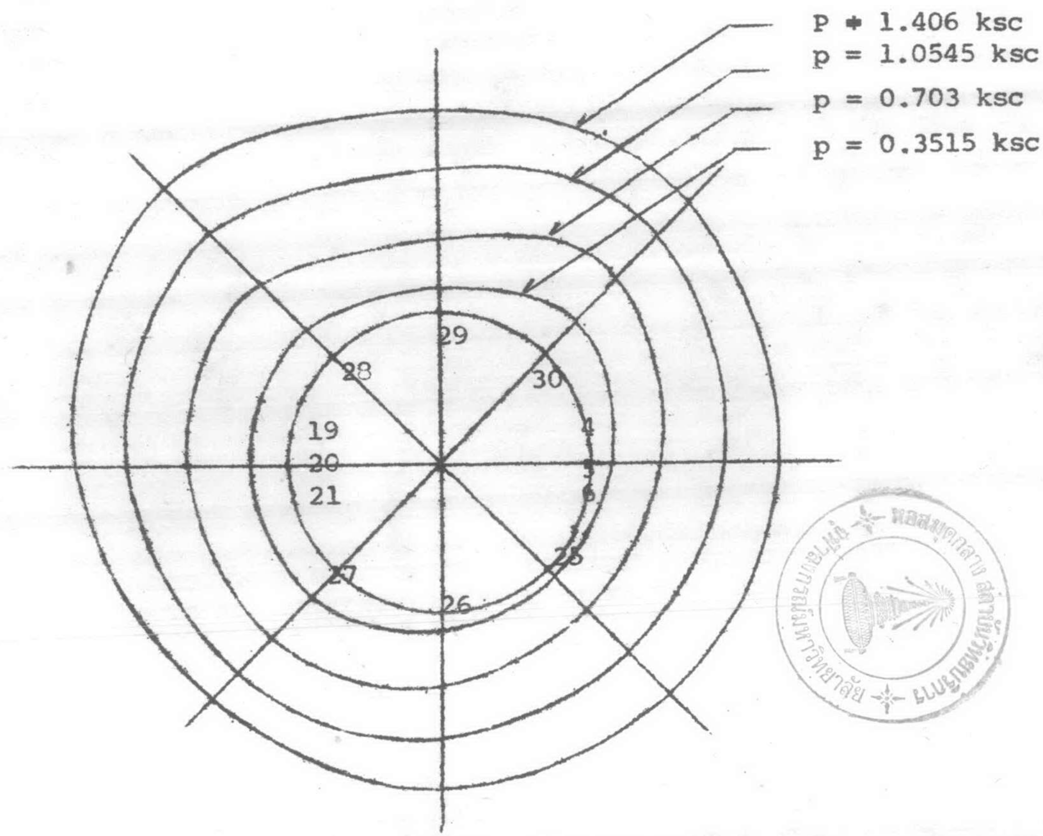

Fig A-16 HOOP STRESSES DISTRIBUTED AROUND A GRP CYLINDRICAL TANK WITH HEMISPHERICAL ENDS

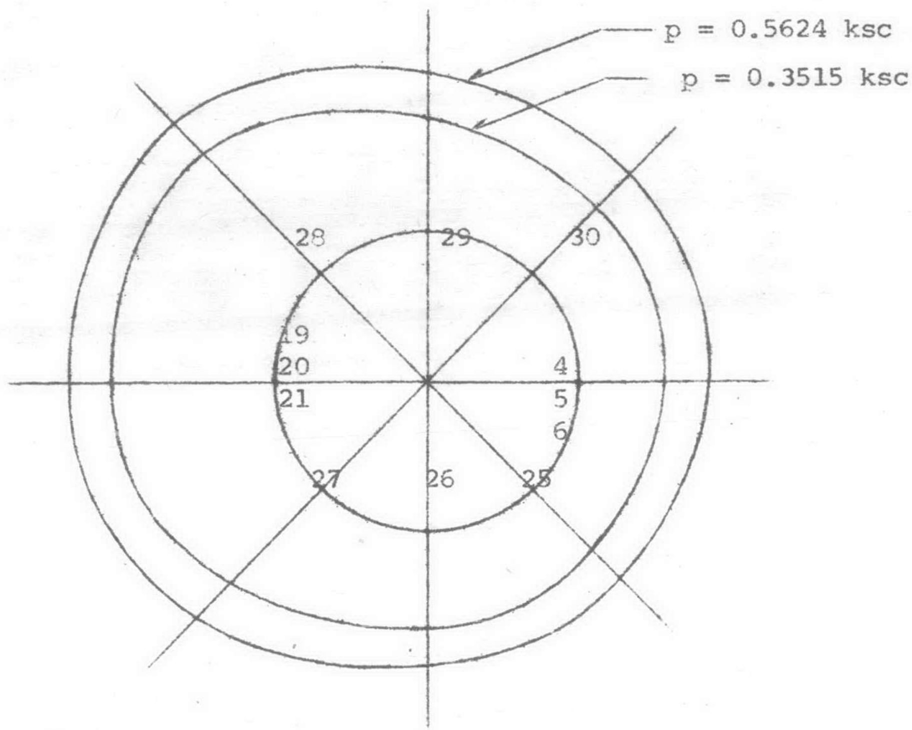

Fig. A-17 HOOP STRESSES DISTRIBUTED AROUND A JRP CYLINDRICAL TANK WITH HEMISPHERICAL ENDS

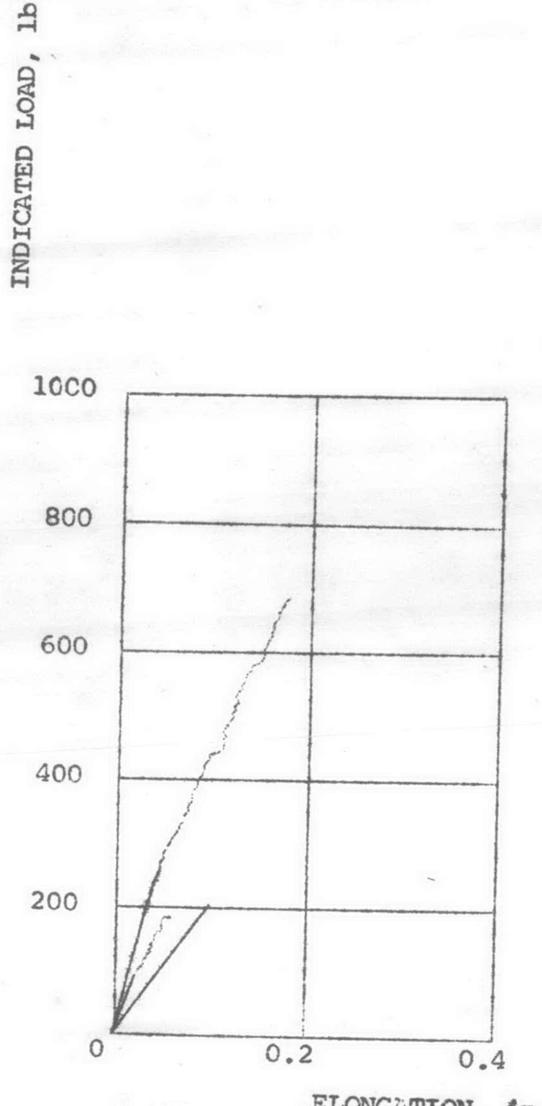

Fig. 18 RELATION BETWEEN INDICATED LOAD AND ELONGATION

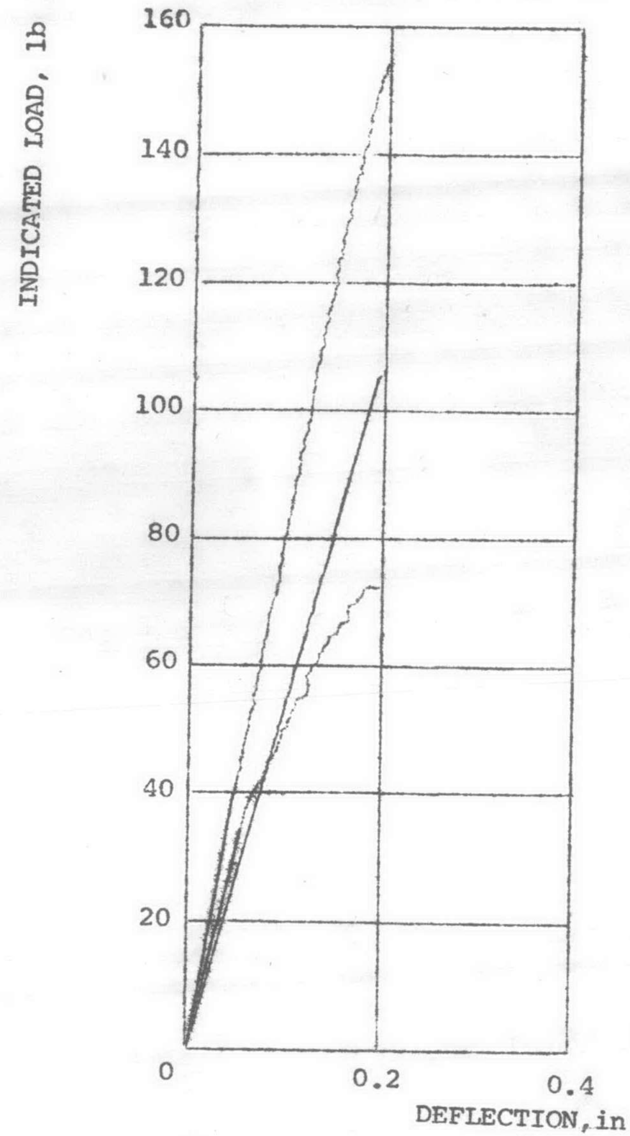

Fig. 19 RELATION BETWEEN INDICATED LOAD AND DEFLECTION

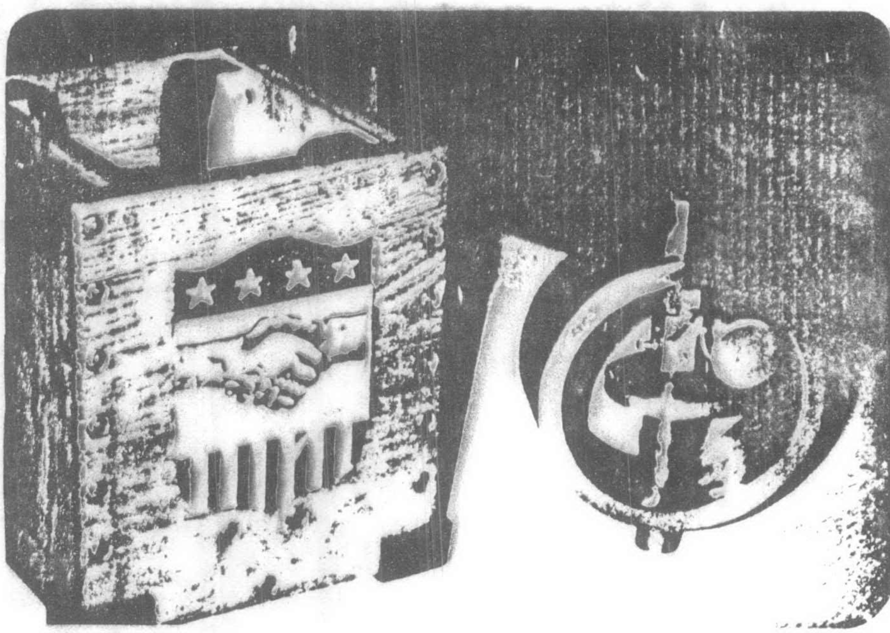

Fig. A - 20 PROVING RING NO. 56180

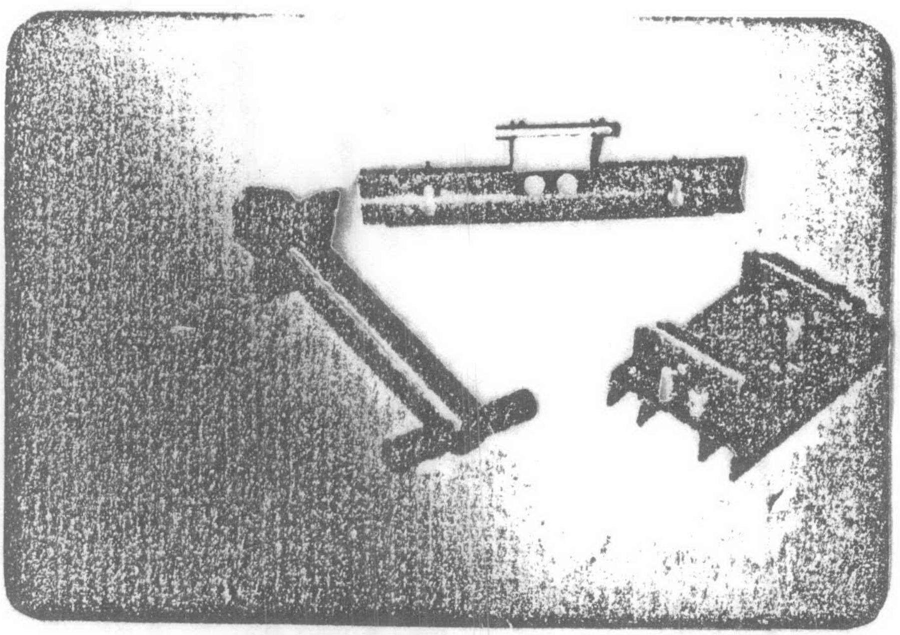

Fig. A - 21.LOADING NOSE AND SUPPORTS

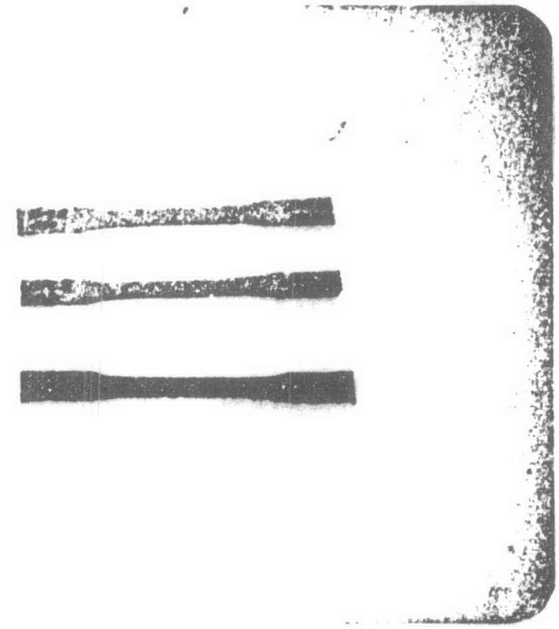

Fig. A - 22 TEST SPECIMENS

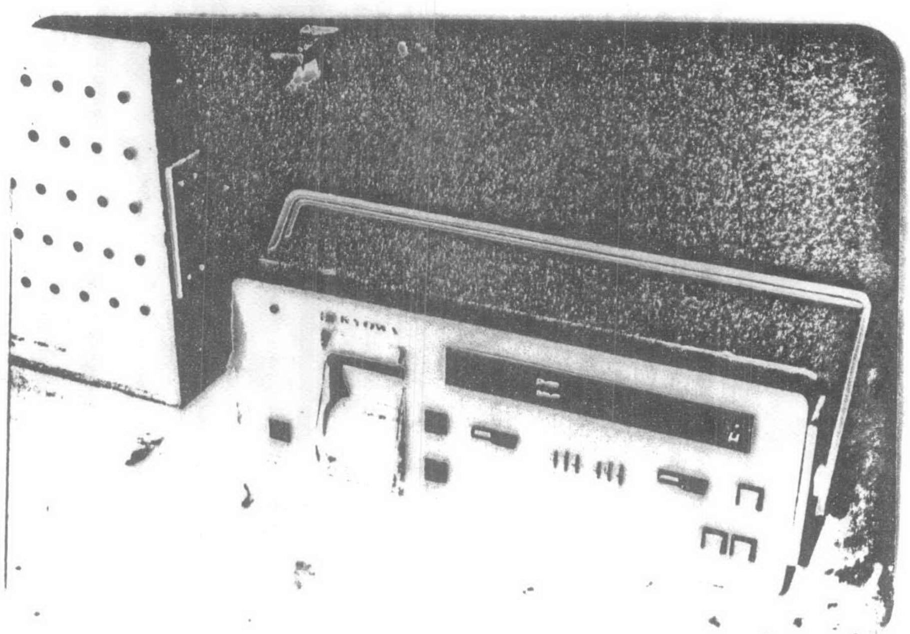

Fig. A - 23 STRAIN GAGE BRIDGE MODEL SD - 520 A

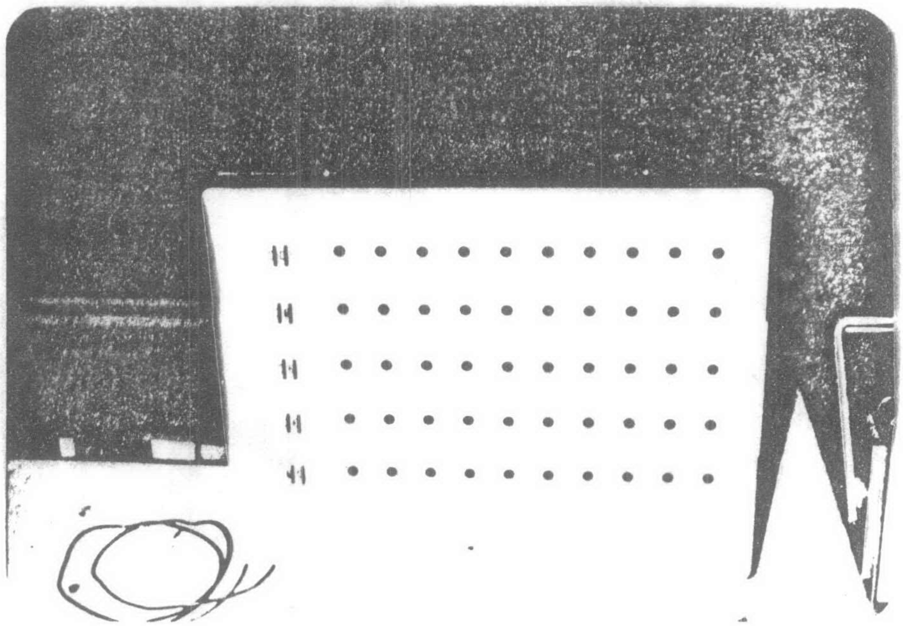

Fig. A -24 AUTOMATIC SCANNING BOX TYPE ASB-55E

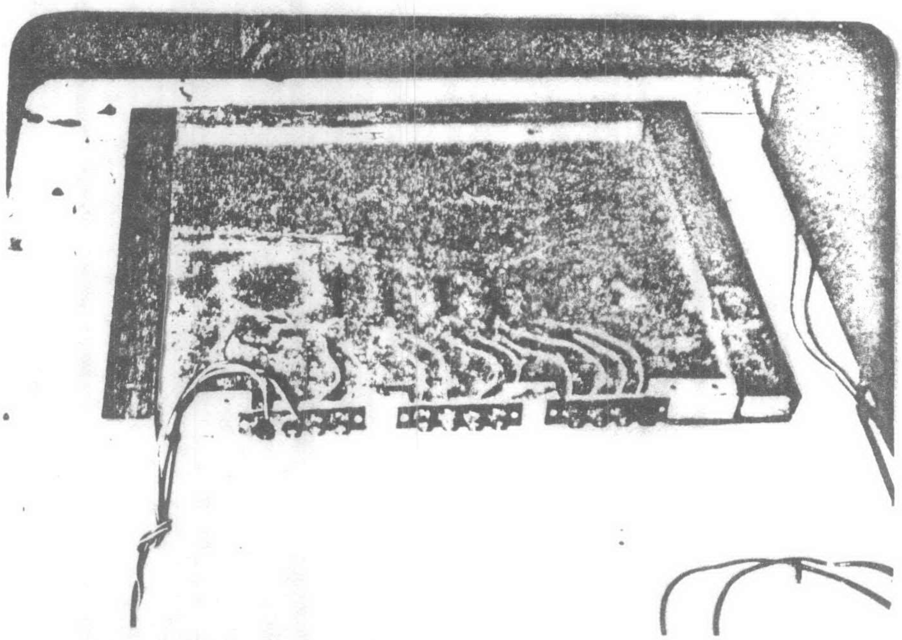

Fig. A - 25 DUMMY GAGE

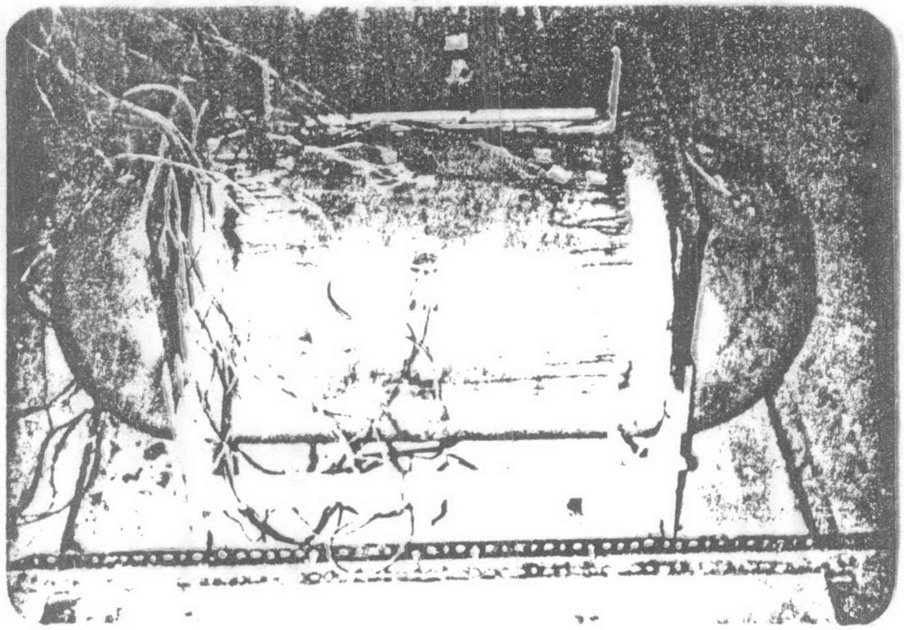

Fig. A - 26. TEST MODEL

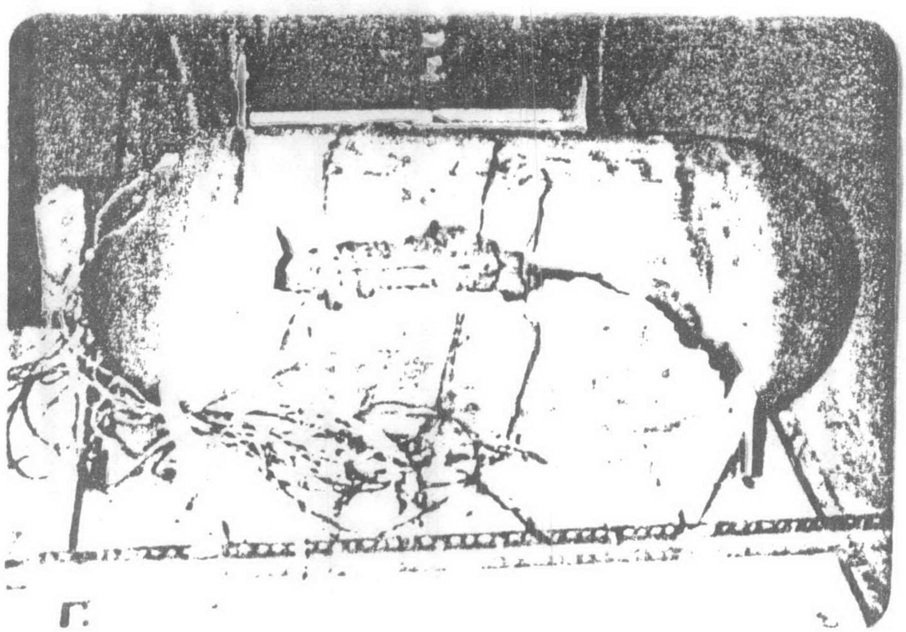

Fig. A -27 TEST MODEL FOR GRP AFTER BREAKING

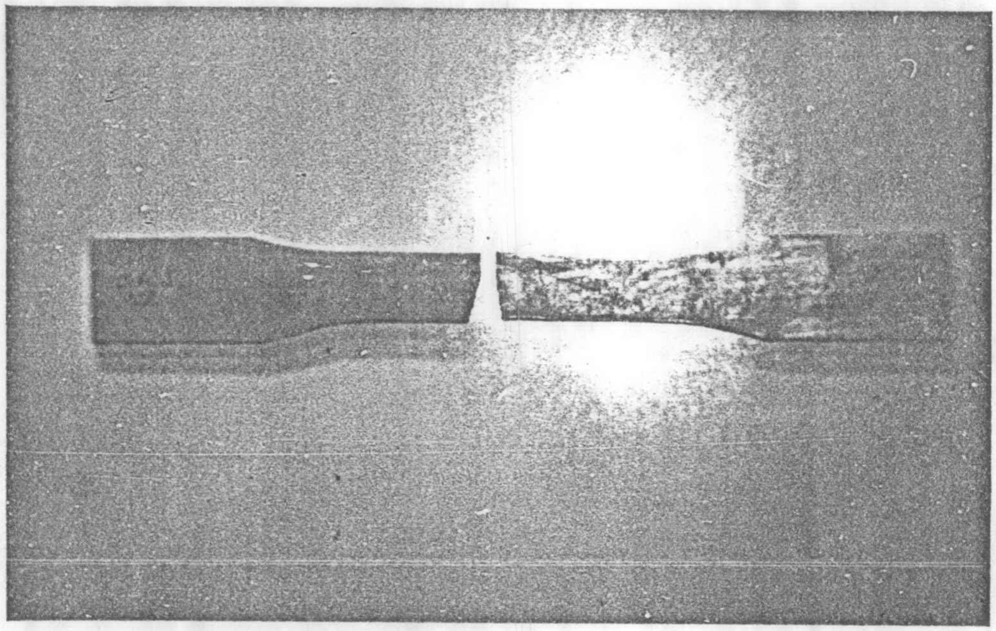

Fig. A-28 TEST SPECIMEN FOR PP AFTER TENSILE TEST

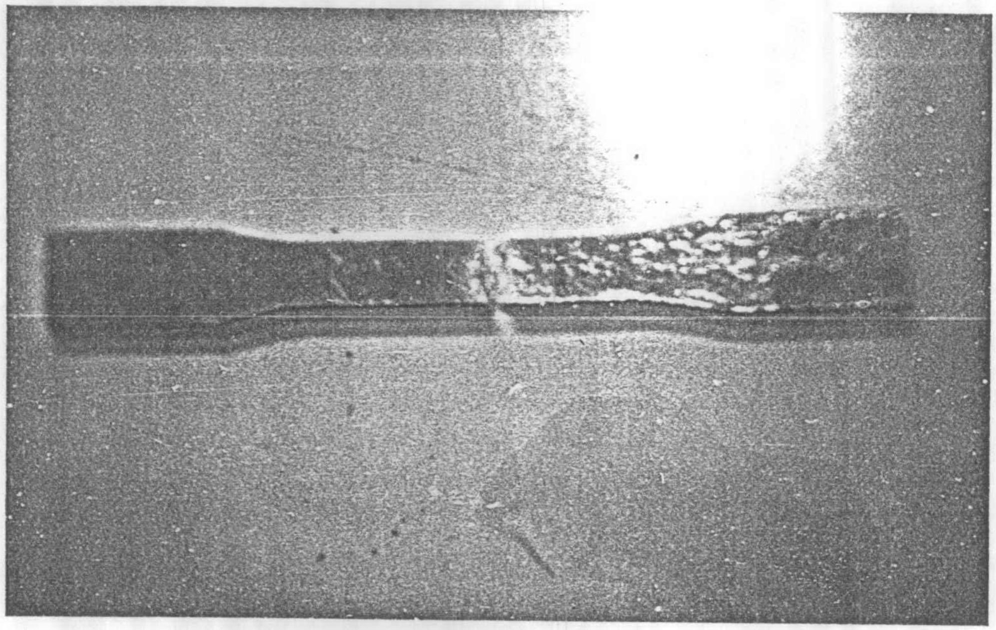

Fig. A-29 TEST SPECIMEN FOR GRP AFTER TENSILE TEST

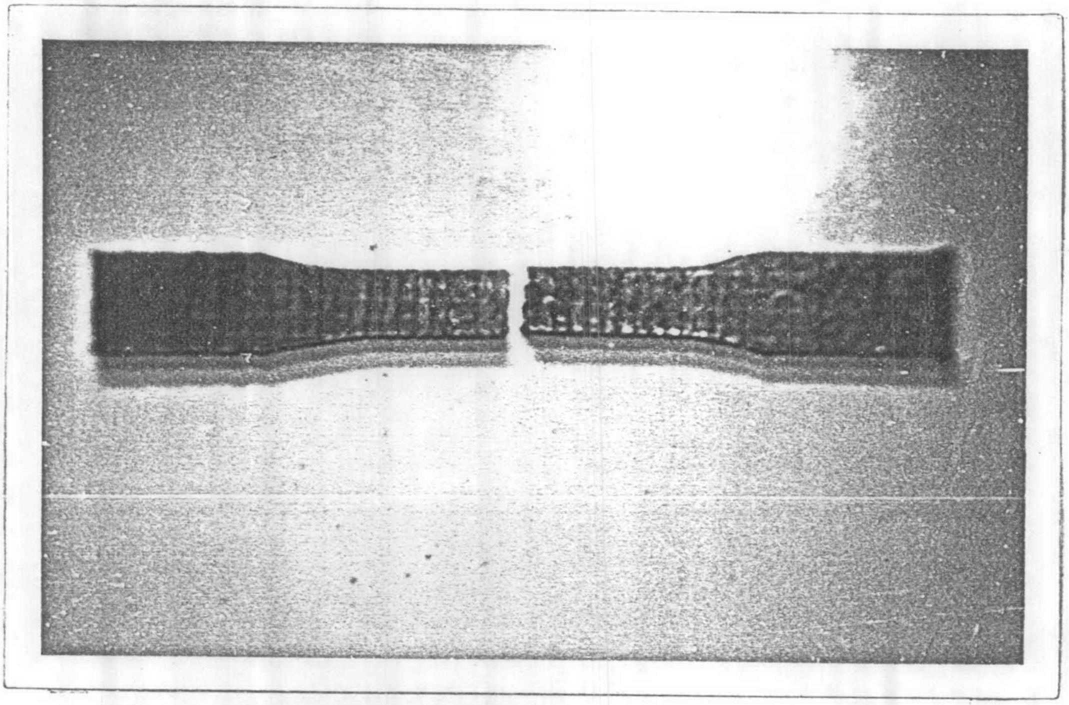

Fig. A-30 TEST SPECIMEN FOR JRP AFTER TENSILE TEST

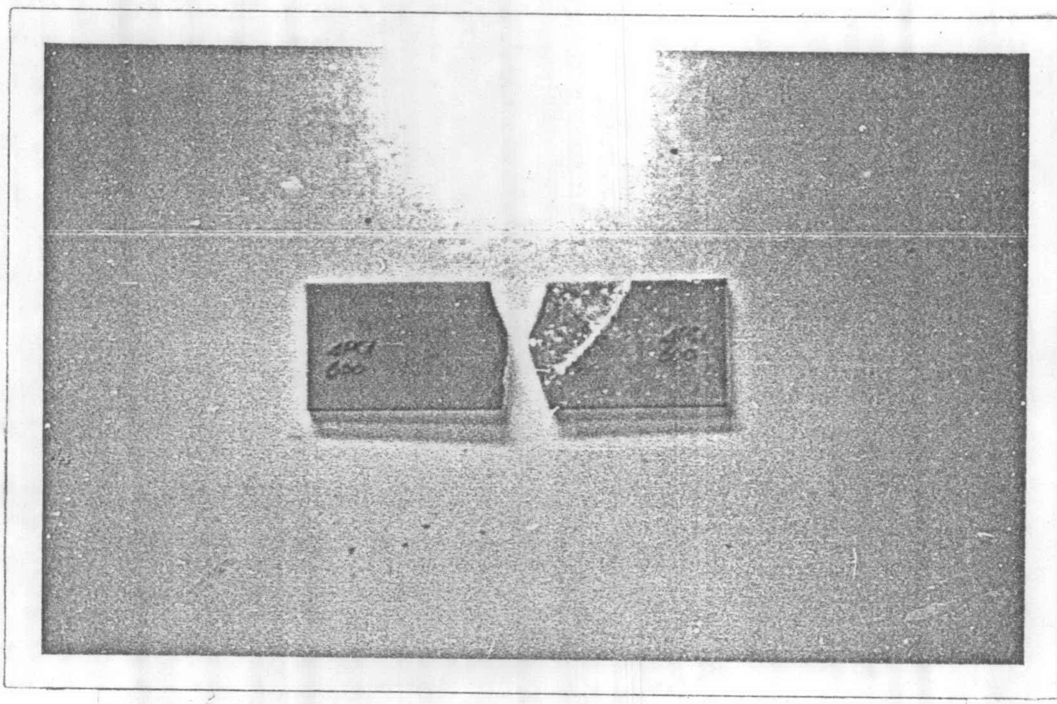

Fig. A-31 TEST SPECIMEN FOR PP AFTER FLEXURAL TEST

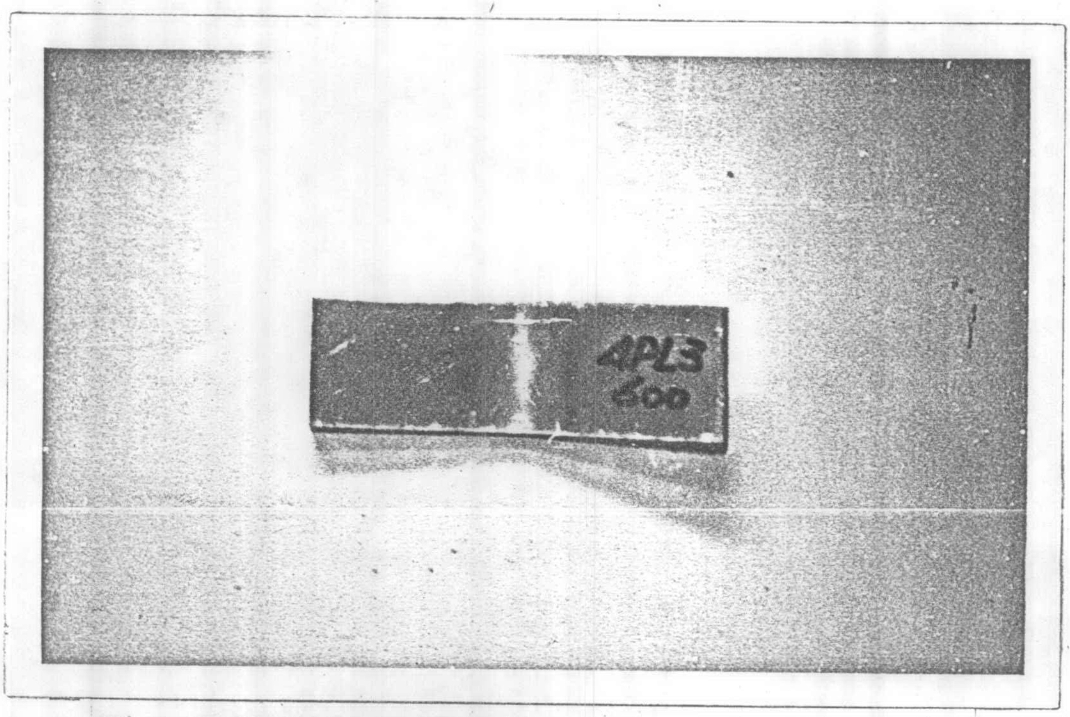

Fig. A-32 TEST SPECIMEN FOR GRP AFTER FLEXURAL TEST

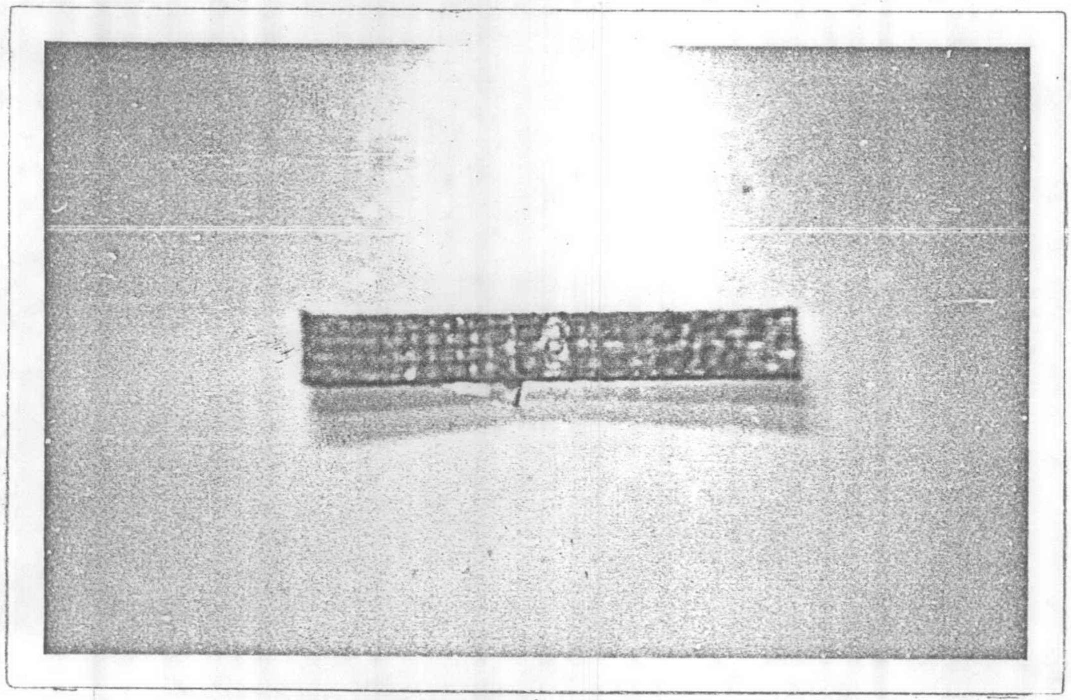

Fig. A-33 TEST SPECIMEN FOR JRP AFTER FLEXURAL TEST

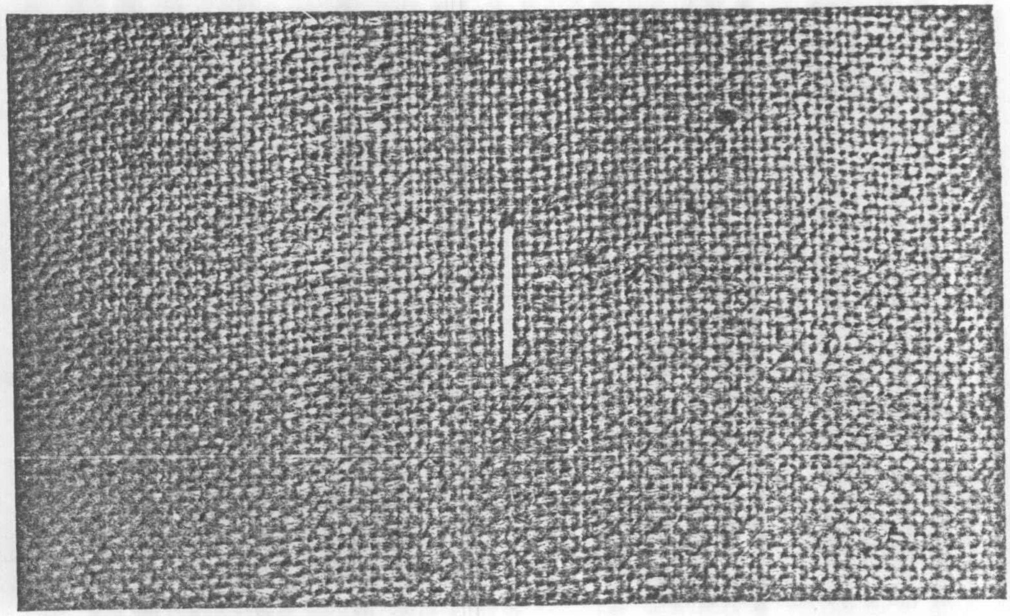

Fig. A-34 BRAIDED JUTE

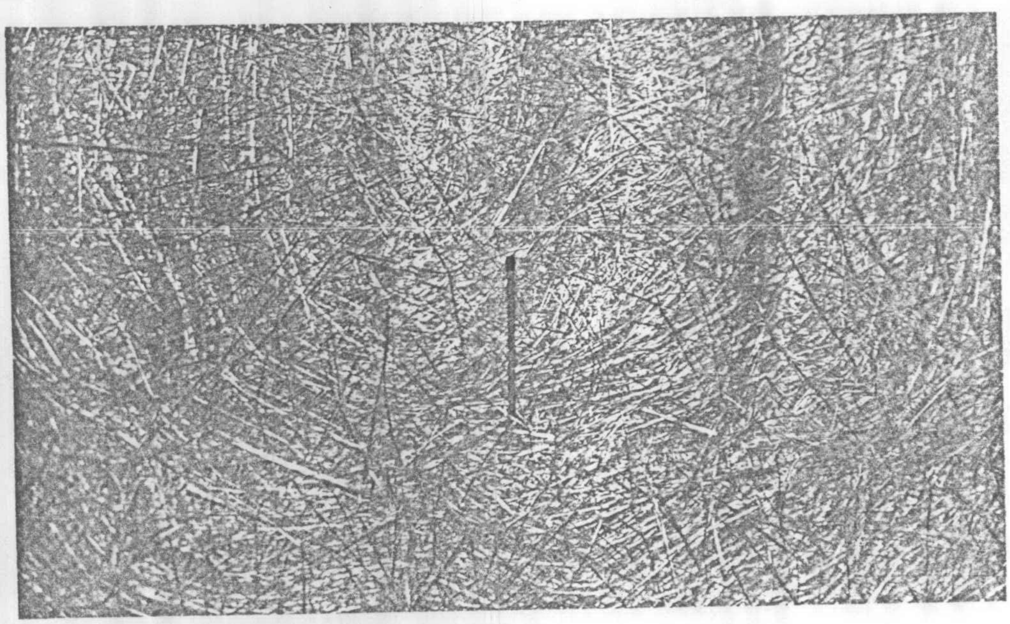

Fig. A-35 CHOPPED STRAND MAT

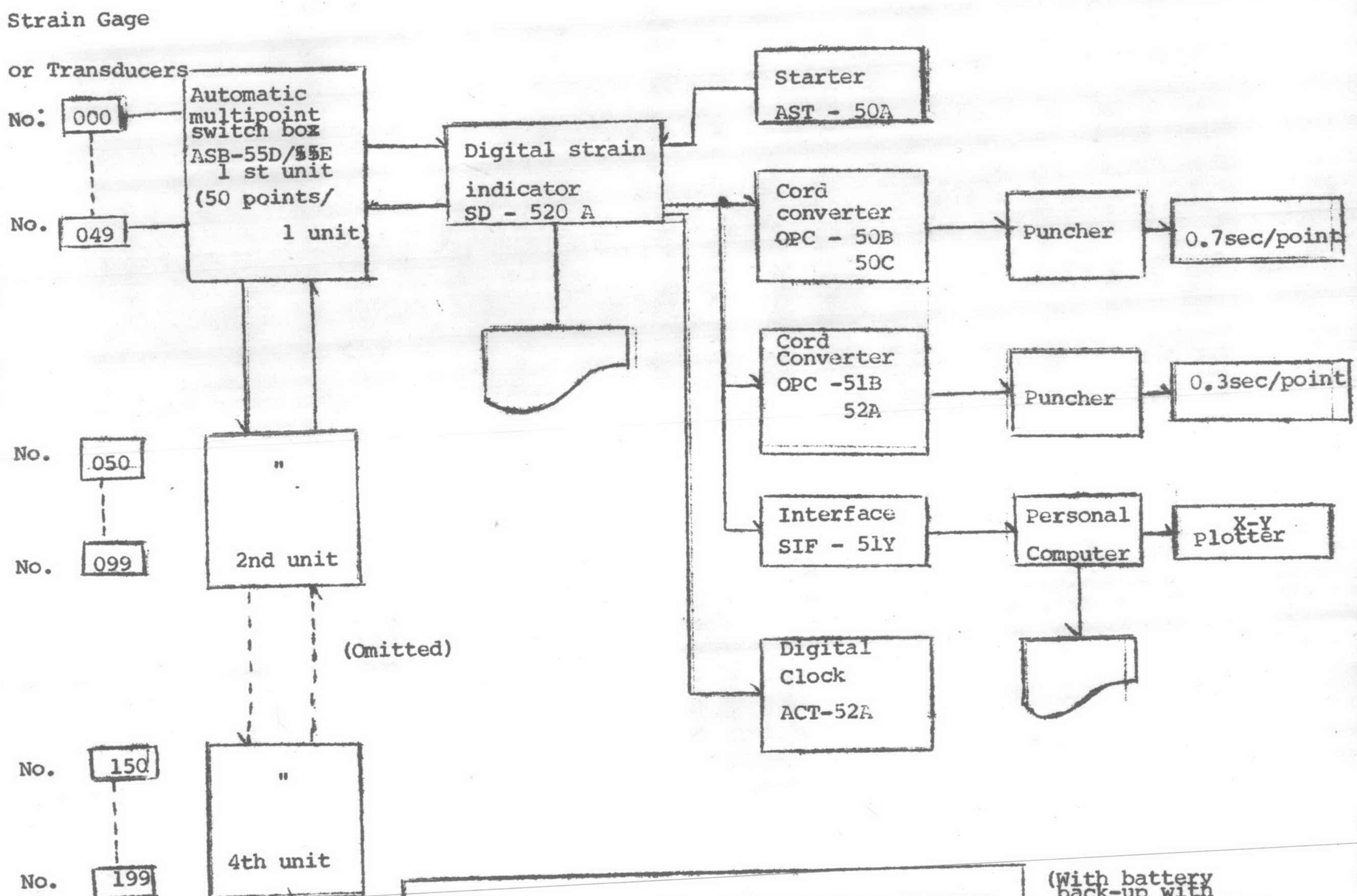

Fig.A-36 BLOCK DIAGRAM OF STRAIN MEASUREMENT